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Jose Ignacio Barrientez

1995

Causes and Effects of Change Orders at Naval Air Station, Corpus Christi, Texas

by

Jose Ignacio Barrientez, B.S.P.E.

Thesis

Presented to the Faculty of the Graduate School
of The University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

MASTER OF SCIENCE IN ENGINEERING

The University of Texas at Austin
August 1995

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at Naval Air Station, Corpus Christi, Texas

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Submitted:

July 21, 1995

ABSTRACT

Causes and Effects of Change Orders
at Naval Air Station, Corpus Christi, Texas
by
Jose Ignacio Barrientez, M.S.E.
The University of Texas at Austin, 1995
SUPERVISOR: Calin M. Popescu

This research studies causes and effects of change orders on construction contracts at Naval Air Station, Corpus Christi, Texas. It involves a comprehensive study of 157 change orders on 61 fixed price construction contracts and a detailed analysis of sources of change and cost and schedule sensitivities for different project types. Of particular significance are the findings related to predominant sources of change which if verified by other studies should steer the U.S. Navy towards modifying its policies towards owner requested changes.

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CHAPTER 1

INTRODUCTION

1.1 MOTIVATION

The Naval Facilities Engineering Command provides field contracting officers with substantial resources in the execution of their delegated authority. Millions of dollars are spent every year to staff field offices and train highly skilled personnel in the area of construction contract administration and management. One of the principal functions of contracting officers is to authorize change orders to construction contracts within strict regulatory guidance. The effort involved in processing change orders is exorbitant. Often times, the individual change orders get filed away in a project folder with no further use except during an occasional audit. The information contained in change order files could be collected and analyzed to study causes and effects of change orders and provide a valuable tool for contracting officers to predict changes under various conditions, develop a course of action to deal with changes more effectively, and program contingencies to expedite execution of change orders.

1.2 PURPOSE

The purpose of this research was to investigate causes and effects of change orders on construction contracts at Naval Air Station, Corpus Christi,

Texas. In particular, the sources of changes and their cost and schedule impacts were studied. Legal topics underlying changes on U.S. Navy contracts were also researched. It is hoped that the results of this study can be used by contracting officers at other activities to better understand change orders and to develop strategies and procedures to better deal with changes.

1.3 SCOPE

The laws relating to changes are complex, widely dispersed, and require substantial interpretation before the legal basis for changes can be fully understood and the changes justified. Many of the procedures practiced by parties to the construction process overlook the rules relating to changes and presume that an owner has an implied right to direct the performance of changed work. A study of the underlying clauses included in a construction contract which might justify changes is appropriate as a prelude to the investigation of actual change orders.

This research included the study of 157 change orders on 61 construction contracts located at or near Naval Air Station, Corpus Christi, Texas. The contracts chosen were all completed (closed out) contracts from FY 93 to the present and represented approximately two-thirds of all active contracts at the station. It was hoped that by not selecting particular types of construction contracts for study, a diverse sampling of the various kinds of projects typically found at a small to medium sized activity could be obtained.

The contracts were all lump sum competitive bid type ranging from $24,000 to $5,191,000.

A root cause was determined for each change order based on a reason code used by the Navy and subjective interpretation based on project documentation. For the purpose of this study, the changes were independently categorized according to several reasons for changes from a published contractor's guide to change orders. The analysis focused on relationships between the various causes of change orders and the impact on cost and schedule. The impact is defined as the net effect the changes have on original contract cost and schedule.

1.4 METHOD

The first phase of the research approach involved analysis of change orders collected, determining root causes, and determining impact. The changes were grouped into their respective projects which were then categorized by specific project types. Change order sensitivities or rates were determined for each project type. The information was then summarized to obtain average sensitivities and predominant causes for the project types. Individual change orders were examined to demonstrate the reasoning used to categorize the projects and recommendations were developed based on the findings.

The second phase involved a study of available literature on the legal aspects of changes as they relate to U.S. Navy contracts. A comprehensive presentation of legal material related to changes including applicable contract clauses, case studies, and a change order checklist is included in Chapter 2.

CHAPTER 2

BACKGROUND

2.1 INTRODUCTION

The laws relating to changes are numerous, complex, and dispersed throughout a maze of several official documents, subdocuments, and court rulings. Every type of construction fixed price contract contains a changes clause in the specifications. Federal government contracts also contain a differing site conditions clause. The American Institute of Architects' define a change order as a written order, whereas the standard changes provision in federal contracts, including the Navy, requires that a written order be designated as a change order. Clauses in a contract may provide that a change order be executed by the owner and the architect/engineer while the Navy allows execution only by the contracting officer. Other provisions of contracts may provide for adjustment of contract price and time by change orders only. Navy contracts provide for method of payment if the parties cannot agree on the payment procedure thereby obligating the contractor to proceed with undefinitized or unsigned change orders. To simplify discussion related to different contract structures and contract responsibilities, only conventional Navy fixed price contracts with designated construction management responsibilities will be addressed in this chapter.

2.2 U. S. NAVY CONSTRUCTION CONTRACTS AND ORGANIZATION

The Military Construction Program (MILCON) for the Department of Defense is directed towards projects that exceed $300,000 in new construction cost and require congressional approval. The congressional definition of new construction includes development, conversion or extension and any combination necessary to produce a complete and usable facility or complete and usable improvement to an existing facility. U.S. Navy instructions further define new construction as the erection, installation, or assembly of a new real property facility; the addition. expansion, extension, alteration, conversion, or replacement of an existing real property facility; or the relocation of a real property facility. Because of the strict congressional approvals required and the monetary limits established for new construction, the Navy relies heavily on its annual Operations and Maintenance budget to support minor construction projects costing less than $300,000 and repair projects which have less oversight and larger monetary limits.

The Navy defines repair as the restoration of a real property facility to such a condition that it may be effectively utilized for its designated purpose. Allowable under this definition is relocation and minor additions to components in an existing facility so it can be restored to its customary state of operating efficiency and replacement of components of systems in a facility with items of higher quality, more durable materials, or larger capacity to conform with current building codes, design criteria, safety standards or environmental regulations. The repair special projects in particular are prone to changes

during construction because of incomplete or impractical design, difficult customer acceptance, and differing site conditions. These types of special projects in the construction phase are the focus of this research.

The administration of repair and minor construction contracts is left to a geographical agent or Officer in Charge of Construction (OICC) who typically delegates his or her construction management responsibilities to a Resident Officer in Charge of Construction (ROICC) who may act as the contracting officer at an activity. Both the OICC and ROICC functions pertain to Engineering Field Divisions (EFD's) which report to the Naval Facilities Engineering Command (NAVFAC) in Washington D.C. which reports directly to the Chief of Naval Operations (CNO) and is assigned the responsibility for maintenance and construction of shore facilities for the Navy worldwide. For convenience, any of the entities listed above will be referred to as the owner or Navy throughout this study.

In the conventional U.S. Navy contract relationship, the Navy contracts directly with the general contractor (GC) for construction and the architect/engineer (AE) for design. The GC enters into individual agreements with and is solely responsible for the work of subcontractors. The Navy looks only to the GC for performance. The subcontractors look to the GC for resolution of problems even if they involve the Navy's contract documents. Figure 2.1 shows a typical contracting relationship.

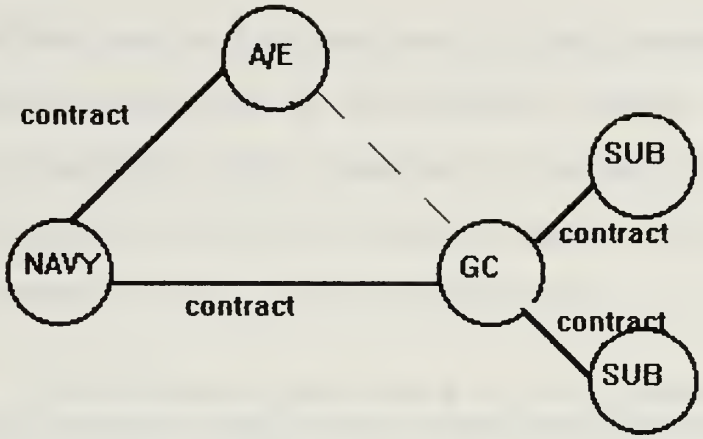

FIGURE 2-1 U.S. NAVY CONTRACT ORGANIZATION

Communications between the owner, A/E, and GC may overlap to some degree during day to day operations. In order to separate the A/E and GC from any implication of a contractual tie, the following general condition is normally included in the specifications:

> The Contract Documents shall not be construed to create any contractual relationship of any kind between the architect and the contractor . . .

2.3 CHANGES CLAUSES

The three principal documents used by Navy contracting officers and which form the legal basis for all contracting actions are the Federal Acquisition Regulations (FAR), Department of Defense Supplement to the FAR (DFARS), and the NAVFAC Contracting Manual (P-68). The Changes clause as spelled out in FAR 52.243-1 reads in part:

> (a) The Contracting Officer may at any time, by written order, and without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes-
>
> (1) In the specifications (including drawings and designs);
> (2) In the method or manner of performance of the work;
> (3) In the Government-furnished facilities, equipment, materials, services, or site; or
> (4) Directing acceleration in the performance of the work.
>
> (b) Any other written or oral order (which, as used in this paragraph (b) includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating (1) the date, circumstances, and the source of the order and (2) that the Contractor regards the order as a change order.
>
> (c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change order under this clause or entitle the Contractor to an equitable adjustment.
>
> (d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an euitable adjustment and modify the contract in writing. . . . . .

In summary, this clause incorporates the following requirements:

1. Adjustments to the contract may only be effected by a change order.

2. The change order must be in writing, signed by the contracting officer.
3. The change order must specify both the adjustment in contract price and net effect on the project time.
4. The change order will be for work within the scope of the original contract.
5. No changed work is to be performed without a properly executed change order.

The changes clause designates the contracting officer as the authority to order the work and to execute written change. NAVFAC P-68, 43.202 "Authority to issue change orders", additionally requires unilateral change orders to be approved by the EFD or equivalent higher authority up to a maximum of $100,000 per change order. A unilateral change order is issued when the government and contractor cannot reach agreement on the cost and time associated with changed or additional work and directs the contractor to proceed with the work despite the absence of an agreement on appropriate compensation. Description of formal authority can be confusing to contractors due to bureaucratic processes, familiarity with past relationships, or constructive actions of the parties involved.

The Navy recognizes that other than owner acknowledged changes can occur. A constructive change order is one that occurs when the owner or an authorized representative acts in such a way that causes a contractor to

perform additional work. This may include verbal and written directives outside a specific change order procedure and may also include any act or omission that has the ultimate effect of changing the work. The most common types of constructive changes are:

Defective specifications

Changes in methods of performance

Misinterpretation of specifications

Overinspection

Rejection of conforming work

Rejection of or equal submissions

Defective owner-furnished property.[1]

It is not normally expected that a contracting officer formally recognize a constructive change. The actions or inactions on the part of the owner that caused the change must be documented as early as possible to make the owner acknowledge the change and secure additional compensation. A United States Court of Claims ruling on constructive change order doctrine stated:

> It is pertinent to know at this point that where a contract contains the standard changes provision and the contracting officer without issuing a formal change order, requires the contractor to perform work or to utilize materials which the contractor regards as being beyond the requirements of the pertinent specifications or drawings, the contractor may elect to treat the contracting officer's directive as a constructive change order and prosecute a claim for an equitable adjustment under the changes provision of the contract.[2]

---

[1]Civitello, Andrew M., Contractor's Guide to Change Orders, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1987, p. 73.

[2]Ets-Hokin Corp. v. United States, 420 F.2d 716 (Ct. Cl. 1970).

Consequential Changes involve additional work that becomes necessary or additional costs incurred as a result of a more obvious change. Additional costs which may become apparent with an associated change order are interference costs, rework costs, delays, and extended overhead. The changes clause allows for equitable adjustment to be made provided written notification of the additional costs incurred is received promptly.

The most common difficulties in applying a changes clause to a Navy contract are disagreement on whether the change does in fact fall within the scope of the contract, having the change in writing and properly executed before any work is performed, and determining if the additional cost and time requirement stated in the contractor's proposal is accurate and reasonable.

2.4 DIFFERING SITE CONDITIONS CLAUSE

Differing site conditions are one of the most disputed areas related to change orders. The federal government was a pioneer in the use of differing site conditions clauses and as such the inclusion of a differing site condition clause in Navy contracts is standard. The purpose of a differing site conditions clause is to allocate risk between the parties. Prior to the inclusion of differing site conditions clauses, contractors carried large contingencies in their bid prices to protect themselves against large losses in the event of

serious site condition problems.[3] The owners were also at risk from a material breach of contract for failing to adequately describe the physical conditions at the job site. The standard differing site conditions clause found in FAR 52.236-02 reads:

> (a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of (1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or (2)unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.
>
> (b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, equitable adjustment shall be made under this clause and the contract modified in writing accordingly.
>
> (c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.
>
> (d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

Of key importance in establishing if a differing site condition clause is applicable for a change is determining whether or not the actual conditions are significantly different from those generally recognized as inherent in the work. Navy contracts contain a site inspection clause requiring the contractor to perform a prebid site inspection. The general rule is that while the contractor is required to make a "reasonable" site inspection, the inspection does not have to be exhaustive. The courts recognize that the contractor has neither

---

[3]Jervis, Bruce M., Construction Law Principles and Practice, McGraw-Hill Book Company, 1988, p. 137.

the time nor the resources to conduct the kind of investigation the owner should have made. It is however, the contractor's obligation to prove the existence of a changed condition and to prove the equitable adjustment to which it is entitled. Nor can a contractor take for granted that a changed condition will result in entitlement.

An example of a documented case in which the contractor was granted an equitable adjustment for a claim occured when a contractor encountered a quantity and rate of flow of water into an excavation in excess of what it had anticipated resulting in delay and additional cost. The board of contractor appeals found that the bidding documents reasonably alerted the contractor to a dewatering problem but did not indicate the potential magnitute of the problem. In addition, a prior contractor had incurred a similar problem at a nearby site and had lost litigation after filing a claim. The board held that the government did have the responsibility to advise the contractor of the experience that the first contractor had.[4]

In another case related to the prebid site inspection clause, the contractor performed a site inspection and failed to notice clogged culverts at the site. As the contractor performed the work, it encountered problems with inadequate drainage and soggy soil and brought a differing site conditions claim against the owner. The Arkansas court of appeals denied the claim

---

[4]Joseph A. Cairone, Inc., 81-2 B.C.A.

saying that a reasonable site inspection would have alerted the contractor to the condition.[5]

Subsurface soil conditions are a common source of differing site condition disputes on Navy contracts. Often times, subsurface investigations are not performed and the contract documents reflect little or no subsurface information. The primary areas of concern are soil composition, presence of debris or contamination, water conditions, and quantity variations. Buried utilities are also a major site condition problem. Differing site conditions due to the condition of existing structural components during building renovations are also common on Navy contracts. Unforseen obstructions, unidentified asbestos, and deteriorated components are typical problems. In order for such a change to be considered a differing site condition, the A/E must have performed a reasonable amount of site investigation as part of the design and the condition must be hidden.

2.5 REASONS FOR CHANGE ORDERS

Sources or reasons for change orders can be general or specific. The Navy uses a general approach in categorizing changes on modification write ups. Reason codes are assigned to modifications to allow reviewers and higher authorities to determine if a change is justified without having to review the entire history behind the change. Generally, "UNFO" or unforseen

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[5]Crookham & Vessels, Inc. v. Larry Moyer Trucking, Inc., 699 S.W.2d 414 (Ark.App. 1985).

changes have little difficulty getting approved. "CREQ" or customer requested changes are more discretionary and may or may not get approved depending on scope and availability of funds. "DSGN" is used for design changes where the A/E is not considered liable for the change. This could be the result of a design error where the additional work would have been required by the contract in any case and would have theoretically been included in the contractor's bid. "EROM" is used for design errors where the A/E is liable or potentially liable for paying for the cost of the change. These changes normally get approved and funded to prevent delays and A/E liability is pursued through a separate process. "CRIT" is used for changes required to meet criteria related to building codes, standards, zoning, etc. One reason for the misuse of reason codes is that there tends to be less scrutiny by higher officials for approving and funding "UNFO" changes as compared to the other reason codes thereby expediting execution.

A more specific set of reason codes listed in a popular construction industry guide book and used in this study includes defective specifications, nondisclosure, lack of coordination among design disciplines, incomplete design, latent conditions, owner changes, improved information, improvements in workmanship, time, or cost, illegal restrictions, nonapplicable boilerplate, and "intent" vs. "included".[6] The predominant reason categories discovered in this study were owner changes and latent or differing site conditions. Delays were also included as a separate category. Each reason

[6]Civitello, p.71.

category will now be presented with possible explanations as to why they were or were not prevalent in the Navy contracts investigated.

"Nondisclosure" is the failure to inform a contractor of information that is significant to the completion of the project. Examples of withheld information which would cause an unanticipated hardship on the contractor might include the presence of rock in the way of excavation or the presence of material with unsuitable bearing capacity. It is unlikely that a government official would intentionally withhold such information due primarily to lack of motive for self gain. Also, deliberate withholding is an unethical tactic with severe consequences. Nondisclosure can also be unintentional when the owner fails to understand the significance of the information witheld.

The amount of repair work present on Navy contracts creates difficulty for coordination of design work among design disciplines. Too often, complete information is not provided to the A/E and the design must progress with many assumptions. Fortunately for A/E's, many of the changes that might otherwise fall under "lack of coordination" are included as latent conditions with the explanation that the proper relevant information was unobtainable by reasonable means. Some examples of lack of coordination among design disciplines are ductwork locations without regard for existing beam locations and erroneous physical dimensions for mechanical equipment. Incomplete design is usually the result of failure to verify that supplemenary information is to be provided by an additional party. It is a failure to

adequately describe work components to the level necessary to complete the work.

"Latent conditions" or "differing site conditions" are common on Navy contracts. They are conditions that were unforseen to the contractor at the time the project was bid. The most common type are subsurface conditions which might include soil composition and contamination, utilities in locations different from those indicated, and the presence of previous disposal areas. The other type are hidden conditions in an existing facility which include discovery of deteriorated or hazardous materials and equipment and different physical configurations from those shown on the drawings.

"Owner changes" involve additional space requirements, increased capacity, better accomodations, etc. These changes are typically requested by the customer funding the project and can have questionable scope. Because out of scope changes are generally not allowed on a contract, the interpretation as to whether an owner change falls within the original scope of the contract can be difficult. Owner changes typically involve redesign and can be confused with design changes. The underlying difference is in who requested the change. Many times however, owner's requirements may change during the course of the work and the change is needed to make the facility more useable. These changes are also prevalent on Navy contracts due to frequent changes in personnel and missions and emerging requirements from the time a project is bid to the time it is completed.

"Improved information" is information that was not available at the time of bid document preparation or may be the result of improved methods. Improvements in workmanship, time, or cost that are initiated by the contractor are only acceptable to the Navy if a cost reduction can be achieved. Acceleration may be initiated by the owner if an earlier completion date is desired. Illegal restrictions involves proprietary specifications, zoning regulations, building code requirements, or special requirements such as explosive safety and runway zones. Nonapplicable boilerplate involves cut and paste specifications that are inappropriate or conflict with the drawings. "Intent" vs. "included" statements refer to general statements used in specifications to cover up design flaws.

2.6 DELAYS

"Construction delay" is categorized as excusable, nonexcusable, or compensable. "Excusable" delays entitle the contractor to a time extension but no additional compensation. Bad weather is the most common type of excusable delay. "Nonexcusable" delay is the result of the contractor's failure to meet its contractual obligations and results in failure to complete the contract within the specified time. "Compensable" delay is caused by the owner's failure to meet its contractual obligations such as timely review of submittals or site access. Compensable delays entitle the contractor to an extension of the performance period and an increase in contract price. It is

common to have more than one cause of delay occur concurrently on Navy contracts. If an excusable delay occurs concurrently with a nonexcusable delay, the general rule is to grant a time extension for the excusable delay only. Similarly, if an excusable delay occurs concurrently with a compensable delay, the contractor is entitled to a time extension but no compensation.

FAR clause 52.249-10, "Default", forms the basis for excusable delays. The applicable section reads in part:

> (b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if-
>
> (1) The delay in completing the work arises from unforseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include (i) acts of God or of the public enemy, (ii) acts of the Government in either its sovereign or contractual capacity, (iii) acts of another Contractor in the performance of a contract with the Government, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and . . .

To prove entitlement for adverse weather delays, a contractor must rely on weather records for the area and the weather occurances claimed must be compared with the historical weather data for that time of year. The weather must also be so severe that it could not have been anticipated. Contracting Officers use discretion when granting weather delays as it is perceived that the time extension does not incurr financial liability to the owner. Contractors

typically claim weather delays to avoid liquidated damages near the completion of a contract.

"Nonexcusable" delay may be defined as any delay which is not compensable or excusable. Liquidated damages stated as a per diem amount in a contract establish the owner's damages for late completion. In order for liquidated damages to be enforceable, the actual damages must be inherently difficult to measure and the stipulated amount must reflect a good faith effort to estimate what the damages might be. Liquidated damages should be an attempt for both parties to establish in advance those damages that should be paid to the owner in the event of late completion of a contract. The standard liquidated damages clause used in Navy contracts is found in FAR 52.212-5, "Liquidated Damages-Construction" and reads:

> (a) If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of ..... for each day of delay.
>
> (b) If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.
>
> (c) If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

Navy contracts contain no specific clause for "compensable" delays. Rather, there are a number of implied obligations on the part of the owner throughout a contract. A breach of any of these implied obligations resulting

in a delay may be considered compensable by many contractors. However, the Navy frequently includes disclaimers of liability for delay in its contracts making delay claims one of the most complicated and contested issues in contracting. The most common causes of compensable delay are failure to provide timely access, clarification of defective drawings or specifications, delays in providing government furnished material, coordination of separate prime contractors, and slow review of contract submittals.[7] The contractor generally must give the owner prompt written notice of any delay which the contractor considers to be compensable and be able to show the increased costs through detailed cost records. One basic legal principle concerning compensable delays is that the contractor has the right to complete the project ahead of schedule allowing compensable delay even though a project may be completed before the contract completion date.

Acceleration, disruption, and suspension of work are issues related to delay but not expressly included in any one of the three categories of delay. If the owner directs additional work to be performed by change order within an original contract period, the contractor may recover its increased costs due to acceleration. The owner is said to have disrupted the contractor's work if it forces the contractor to perform work out of sequence or interrupts work in progress. The damages caused to a contractor because of disruption are difficult to prove because they typically involve lost efficiency which is difficult to quantify. The suspension of work clause is included on Navy contracts and

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[7]Jervis, p. 124.

gives the owner the right to order the contractor to suspend all or a portion of its operation. The result is that the owner may stop the work for a reasonable period of time without having to compensate the contractor. A suspension of work of several hours to resolve some unexpected field condition would be considered reasonable. A contractor may recover documented increased costs if the suspension extends the performance period but may not recover profit. The suspension of work clause found in FAR 52.212-12 reads:

> (a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.
>
> (b) If the performance of all or part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract. . . . . .

A classic example of a documented claim against the government for delays occured when a contract called for installation of meters in military housing units. The contractor's construction schedule was submitted and approved as required. However, the government failed to provide access to the units in an orderly fashion thus disrupting the sequence of work. The U.S. Court of Appeals ruled that the failure to provide access to the housing units

in a logical, sequential fashion was a disruption of the contractor's work and the contractor was entitled to recover the increased costs caused by the disruption.[8]

2.7 CHANGE ORDER PROCESS

The basic steps involved in processing change orders are prospecting, preparing, pricing, presenting, performing, and payment.[9] Prudent contractors are quick to discover additional work and understand the need for immediate resolution to guarantee payment and reduce tensions. The so called "art" of change orders lies in the ability of contractors to search and discover potential extra cost items in a timely fashion to expedite approval of change orders and subsequent payment. This strategy is not so bad for the government provided the contractor does not create a paperwork battle. There are many instances in Navy contracts in which contractors have deliberately submitted last minute requests for equitable adjustments in order to catch the government off guard and force a quick decision. The following discovery checklist might be used by contractors and government officials alike in heading off potential change orders.

CHANGE ORDER DISCOVERY CHECKLIST[10]

A. PRE-DESIGN

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[8]Blinderman Construction Co., Inc. v. United States, 695 F.2d 552 (Fed.Cir. 1982).
[9]Civitello, p. 87.
[10]Civitello, p.183.

1. Adjacent Properties
    a. Have all properties adjacent to the site perimeter been reviewed in detail?
    b. Are there:
        Seasonal watercourses?
        Heavy traffic patterns?
        Other independent construction activities?
2. Boring (Subsurface data)
    a. Are boring depths inconsistant?
    b. Are boring locations erratic or unusual?
    c. Are boring locations relevant to construction?
        Are borings provided outside the area?
        Are gaps left within the building area?
    d. What time of year were the borings taken?
3. Building Code Compliance
    a. Have any violations of the building codes been observed by any building official when the building permit was applied for?
    b. Do any portions of the design appear out of the ordinary?
        Headroom?
        Entrances/exits?
        Handicap provisions?
        Fire separations?
        Lighting?
        Ventilation?
        Other?
4. Easements/Rights of Way
    a. Are there designated easements?
    b. If so, will they adversely affect your operation?
    c. Do local traffic patterns restrict access?
    d. Are there parking areas, traffic patterns, business, etc., at the contract limit line that will restrict operations in any way?
    e. If 4.a is yes, do you know all conditions?
    f. If a restriction to your operation is evident, has your estimate accommodated it in some way?
    g. If 4.f is no, should a reasonable prebid site investigation disclose the condition?
5. Inland Wetland Approvals
    a. Does any portion of the site encroach on inland wetlands?
    b. If so, are all appropriate approvals in place?
    c. If required approvals are not apparent, have you requested the confirming information from the owner?
6. Interference of Utilities Not Properly Shown
    a. Have the characteristics of all existing utilities been

verified with each respective company?
b. Has each company representative reviewed the details with you at the site?
c. Is anything different from that represented on the plans?
d. Are the current utility charges for the various tie-ins the same as those given at the time of bid?

7. Plan Approvals (Building Permit)
   a. Has the building permit been applied for at the earliest possible time?
   b. Were there any problems?
   c. Were there any notes or corrections made on the plans?
   d. Has the permit been delayed in any way?
   e. Is a permit required (and a Certificate of Occupancy necessary) for temporary field offices?
8. Temporary Utilities--Availability Within Contract Limit Lines
   a. Have you confirmed the anticipated conditions at the time of bid?
   b. Are conditions adequate?
   c. Are site conditions now different?
      Are additional telephone/power poles needed?
      Is power available at all (without generating equipment)?
      Is previously anticipated use of existing facilities now prevented?
      Is temporary heat and protection now required due to owner caused delay?
      Is water available in sufficient amounts for construction?

B. THE CONTRACT AND BID DOCUMENTS
1. Award Date
   a. Has an extension the contract award date been requested?
   b. If so, is there any basis upon which to ask for an increase in the contract sum?
      Will acceleration be necessary?
      Will a portion of the project now be placed into winter conditions as a result of the start up delay?
   c. Do you have the strength to now require more favorable contract terms:
      Is your bid substantially lower than the next bidder's?
      Can you complete the facility in less time than your competitors?

Were you involved in the design development?
Is the owner tied to you in any way?

2. Named Subcontracts
    a. Are there owner-selected subcontracts on the project?
    b. Does any disclaimer exist that limits the owner's liability for subcontractor selection?
    c. Are the subcontract agreements themselves owner defined?
    d. Is any specific procedure in place to resolve disputes between two owner defined subcontracts?
    e. Will the owner in fact make decisions (or will there be constant attempts to drop the responsibility on the general contractor)?
3. (Price/Bid) Allowances
    a. Are there allowances anywhere in the contract?
    b. If so, have all allowance items been bid or rebid yet?
    c. Have or will all allowance items been awarded in time to prevent schedule interruption?
4. (Contract) Time
    a. Did the first schedule draft drastically exceed the allowed contract time?
    b. Did subsequent schedule drafts incorporate unusual or excessive compressions and accelerations?
    c. Did any long-lead time purchases dramatically exceed the originally anticipated items?
    d. If so, were they for specified items?
    e. Had the contract award date been extended?
    f. Had the site start date been extended for an owner-caused reason?
    g. If the answer to either 4.d or 4.e is yes, was the schedule logic affected?
    h. Did extra work result?
    i. Can clear cause-effect relationships be demonstrated to justify more contract time?

C. PLANS AND SPECIFICATIONS
1. As Indicated
    a. Are notes without specific reference common (such as "As Indicated," "See Specs," "See Plans," and so on)?
    b. Have you taken the time to research each one to confirm that completing details do in fact exist?
    c. If so, have you discovered incomplete, conflicting, or missing references?
    d. If so, have you cataloged each instance for individual consideration?

2. Ceiling Spaces (Conflicts)
    a. Is there a contract clause clearly noting the sub- or trade contractor to be responsible for coordination of their work?
    b. Have all areas of potential conflict in the ceilings been properly coordinated:
        Is there enough room to pitch all pipe?
        Do pitched lines miss all steel and concrete beams?
        Can all ducts pass below beams at all locations shown?
        Do too many items occupy the same space in any area?
        If so, can enough space be made, or can anything be moved?
        Are there large ducts shown to cross large beams and/or other significant obstructions?
        Will all light fixtures fit in the remaining spaces?
        Are there elaborate architectural, structural, or special shapes continuing into the ceiling?
        If so, do other building systems or equipment penetrate any part of them?
        If so, have you confirmed the actual size of everything?
4. Changed Existing Conditions
    a. Has the estimate been reviewed for:
        All sitework considerations?
        Any interferences with existing structures?
        Any noted conditions of existing structures?
        Locations, extent, makeup, and conditions of existing utilities?
        Traffic patterns and site access?
        Anticipated storage and staging areas?
        Parking and security arrangements?
    b. Have the estimators involved met with you at the site to review all items in (a)?
    c. Have any changes between conditions existing now and those existing at the time of bid become apparent?
5. Column and Beam Locations
    a. Have the structural drawings been reviewed in detail:
        Are column layouts erratic or unusual?
        Are there any unusually long spans requiring relatively large structural members?
        Are there unusual shapes, angles, slopes, or connections?
        Are elevation changes strained or confusing?

Are beam sizes all different (with different ceiling spaces below them)?
Have the locations of all large beams been reviewed?
Are there unusual designs?
If so, is enough information included for proper shop drawing preparation the first time around?

b. After reviewing the architectural, plumbing, HVAC, and electrical plans:
Are listed column line dimensions between all designs consistent?
Are there large ducts shown crossing large beams?
Are there light fixtures in the areas of large ducts?
Does the sprinkler main cross large beams, ducts, or light fixtures?
Do random spotchecks of architectural dimension strings reveal any discrepancies?

6. Design Change Telltales
   a. Are there a large number of apparent last minute design changes? Are there:
      Different styles of type or handwriting in the specifications?
      Incomplete erasures?
      Out of sequence reference marks or inserted pages in the specifications?
      Different handwriting on the plans?
      Different use of language for the same or similar remarks?
7. Design Discipline Interfaces
   a. Has any review to this point revealed any problems at the points where design disciplines cross each other?
8. Duplications of Design
   a. Have any duplications been observed?
   b. If so:
      Is each description complete?
      Are the descriptions in different specification sections with different contractors involved?
      Are the duplications included in the same specification?
      Is the same work specified twice?
      Is different work specified for the same function?
      Is any of the available options preferred?

c. In a review of relevant contracts, plans, and specifications:
   - Are any or all contracts of an adhesion format?
   - Are any subcontracts owner selected?
   - Are the affected subcontracts "per plans and specs"?
   - Are there modifications to any contract?
   - Are the rules of precedence outlined in the specification?
   - Are all affected plans noted to be the responsibility of the affected subcontractor(s)?
   - Does the descriptions of work included in the affected and related specification sections help your case?

d. Objectively analyze each duplication:
   - Have all the reasons why each subcontractor should and should not have carried the work in their bids been considered?
   - Should any contractor aware of the work have reasonably construed it to be included by another trade?
   - Did anyone request clarification from the owner prior to bid?
   - If so, is the request and/or response documented?
   - Is each duplication clear and complete in itself?

e. Is there a preferred solution:
   - Does any solution involve your own time or money?
   - Are the dollor estimates of each solution a consideration?
   - Is the timing of any solution particularly good or bad?
   - Is any potentially affected contractor more inclined to accept the extra work?
   - Does any solution make more sense?

f. Do grounds exist to convince the owner that duplicated work is in fact not included anywhere?

9. "Fat" Specifications

a. Does a review of the documents reveal:
   - An unusually fat "front end"?
   - Extensive duplication in the general provisions?
   - Long and/or labored descriptions and instructions?
   - "Catch all" phrases and boilerplate not specifically applying to project conditions?

10. Finish Schedule vs. Specification Index

a. In a comparison of the Finish Schedule to the Specification Index:
    Is each item accounted for?
    Is each item included only once?

11. Inadequate Level of Detail/Missing Details
    a. If enough design information has not been originally provided:
        Will the architect respond now with the complete information?
        Is it confirmed in writing?
        Are there additional cost implications?

12. Light Fixture Locations
    a. In overlaying the lighting plans on the reflected ceiling plans, are there conflicts in:
        Ceiling light fixtures?
        Emergency lights?
        Soffit lights?
        Exit lights?
        Undercabinet lights?
    b. In overlaying the architectural plans, are there conflicts in walls, soffits, or cabinets?
    c. In overlaying the HVAC plans:
        Are there conflicts in register, grille, and diffuser locations?
        Are equipment actual sizes accommodated?
        Does everything miss the lights?
    d. In overlaying the sprinkler plans:
        Do the heads miss the lights?
        Do the heads fall in the center or quarter center of the ceiling tile?
        Is there an architectural pattern in the ceiling tile that will change location preference?
    e. In overlaying the electrical plans:
        Do the smoke detectors miss the lights?

13. Match Lines and Plan Orientations
    a. Are match lines present?
    b. If so:
        Are they necessary?
        Are they in the same location every time?
        Do they include the same information?
        Is anything missing?
        Are they complete and to the same extent on every plan?
    c. Is the north arrow in the same place on each drawing?
    d. Are the orientations the same for each plan?

14. Mechanical,Electrical, and N.I.C. Equipment
    a. Are differences highlighted in all approval

submissions?
b. Has the Letter to Subcontractors regarding contract equipment coordination been sent?
c. Has the Letter to Owner regarding contract equipment coordination been sent?

15. Numerous Details and Dimension Strings
    a. Have repeated designs been observed?
    b. Are there many instances of multiple dimension strings?
    c. If so, have spotchecks uncovered errors?
16. Performance and Procedure Specifications
    a. Are there any instances in which both the performance and procedure specifications occur for the same item?
    b. If so:
        Are they mutually exclusive?
        Can they be made to be compatible?
        Is one or the other more expensive?
        Is one preferred over the other?
        Has one been included in the Schedule of Values?
        Is it cost prohibitive to accomplish both?
        Is time or material availability a factor?
        Is one more complete or otherwise more appropriate?
    c. Is one preferred over the other?
    d. Have all the details and arguments supporting your position been assembled?
17. Proprietary Restrictions
    a. Does the specification being considered:
        Name fewer than three acceptable suppliers?
        Include the words "or equal"?
    b. Do you intend to use an "equal" product?
    c. If so, does the owner want a credit change order?
    d. If so, have you considered a letter to the owner regarding equal to proprietary item?
    e. Has the owner rejected your "equal" submission?
    f. If so, have you considered a sample letter to the owner regarding rejection of equal to proprietary item?
18. Specification Section "Scopes"
    a. Does the design coordination process appear to have been done correctly?
    b. Are specific cross references included?
    c. Does the scope section appear to be complete?

D. SITE

1. Grades, Elevations, and Contours

a. Has the entire site been photographed before any work has begun?
b. Have the existing grades been spotchecked for accuracy?
c. If so, have any discrepancies been discovered?
d. If so, has a detailed check been arranged?
e. Have the locations of existing telephone, water, sewer,fuel tanks and lines, and gas lines been verified?
f. Have the manholes been opened to spotcheck actual pipe invert elevations?
g. Have the locations of telephone poles, street signs, pole guys, and any other construction been checked to avoid interference with site impovements?
h. Have the actual horizontal distances among telephone poles, light poles, manholes, drainage structures, etc., been checked for accuracy?
i. Have any discrepancies discovered been documented in the most accurate and unquestionable manner available?

Preparation involves establishing a change order file, researching change orders after discovery, and notifying the owner of any changes. A common strategy for contractors is to submit a general notification letter early in the project which documents the fact that a change has or will occur based on the change order research. The primary objective of such a letter is to document the fact that the plans and specifications are not flawless and to put the burden on the owner to take steps to resolve any potential problems in a timely fashion. The notification letter serves to notify the owner that a change has occured, an effect on contract price and time is anticipated, the contract notice provision has been met, and that a detailed cost and time proposal will be prepared. A statement concerning the right to claim additional costs resulting from unanticipated work, unforseen effects, and related delays may also be included. The Navy may include an intermediate step in the process

by requiring a request for proposal (RFP) from the government prior to the contractor submitting cost data.

Pricing a change order is a complicated subject that goes beyond the scope of this research. Nevertheless, the primary strategy for a contractor is to present the maximum position that can be justified. This strategy includes making a decision as to whether or not to start the work pending finalization of the change. On Navy contracts, the history of the contracting officer's actions on past change proposals and the actions relative to past promises and commitments usually determine this decision. It has been proven that there are circumstances in which performing work before a change is finalized can save substantial schedule delay.[11] These might involve relatively small change orders that have the potential of disproportionate impacts on construction sequence. Another circumstance might be when the work is unusual and is too difficult to price in which case the contractor might proceed on a time and material basis.

The Navy has standardized procedures and forms for presenting change orders. Allowable mark ups for overhead and profit are typically applied to the direct cost of a change order. Any claims for extended overhead or indirect costs must be listed separately. An additional element which is required is the change to contract time. Factors which should be

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[11] Suhanic, George, "Change Orders Impact on Construction Cost and Schedule", 1980 Transactions of the American Association of Cost Engineers, Washington, D.C.

considered when determining the schedule impact are activity cause-effect relationships, schedule logic and effect on contract time, and establishing a value to time. In practice, the factors which are generally considered when presenting a proposal for additional time are material deliveries, time required to do the work, and stage relative to contract completion date. Contracting officers generally employ liberal discretion in granting time extensions for additional work due mainly to the perception that any additional time granted is noncompensable when standard percentages for overhead and profit are used. This practice may also serve to avoid penalizing late contractors with liquidated damages for otherwise good work.

Performance of work after a change order has been finalized does not necessarily mean that a contractor is not entitled to additional costs due to overruns. An equitable adjustment can usually be made if the contractor can prove that the overruns were due to conditions unforeseen at the time of the original change proposal or if the owner fails to comply with some condition related to the proposal. The Navy takes steps to protect itself from escalation of costs and schedule after a change order becomes executed by including the following wording on change orders:

> **Acceptance of this Modification by the Contractor constitutes an accord and satisfaction and represents payment in full (for both time and money) for any and all costs, impact effect, and/or delays arising out of, or incidental to, the work as herein revised and/or the extension of the contract completion time.**

Similarly, contractors may strengthen their right to claim an equitable adjustment by inclusion of the following wording on a change proposal:

> **The amount of costs and extended completion date allowed by this contract modification (or agreed by the parties) do not include any amounts for extended overhead, rescheduling, acceleration, disruptions, inefficiency costs, and other impacts, and the right is expressly reserved to make claim for any and all of these and related items of cost prior to any final settlement of this contract.**

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The projects researched were collected from the archives at the ROICC Office at Naval Air Station, Corpus Christi, Tx. Project folders were filed according to the fiscal years the projects were completed and the contract numbers. The contract number is a twelve digit character and number coding used to identify each contract. The last 6 digits of this coding were used to identify the projects throughout the data presentation and analysis of this research. The first two numbers of the 6 digits used are the fiscal year the contracts were awarded. The last 4 digits are a sequential numbering of contracts awarded for each fiscal year. The contracts available for review ranged in price from $24,222 to $5,191,000 with an average contract price of $537,000. The contract periods ranged from 90 to 720 calendar days with an average contract period of 250 calendar days. Most of the contracts were of 365 calendar day or one year duration. All of the contracts were completed from FY 93 to the present.

3.2 DATA GATHERING

The project data was collected at the ROICC office, NAS Corpus Christi, Texas during the week of 13 March 1995. The modification file from

each project folder was read and every modification was logged and numbered sequentially. The change order amount, time extension, engineering discipline involved, and Navy reason code for each modification was recorded along with basic project information including award amount and award date. Each modification was then analyzed to determine a more specific reason for the change adapted from "Contractors Guide to Change Orders" by Andrew M. Civitello, Jr. The changes were categorized according to 5 predominant sources: (1) delay, (2) improved information, (3) design, (4) differing site conditions, and (5) owner changes. These groups are explained in Chapter 2 of this research. An excel spreadsheet was created with all the above mentioned data. Different sorts of the data collected are presented in the appendix of this thesis. Additional monthly summary reports used by the ROICC office at NAS Corpus Christi, Tx were used to verify data and obtain actual completion dates.

3.3 ANALYSIS METHODS

The first analysis focused on categorizing the change orders by source or reason and determining totals of additional contract cost and time. This analysis would only serve to provide Navy officials with a measure of the relative impact caused by different sources of change on a base for a given period of time and would have little external significance. Pie charts were developed to present the relative percentages of cost and schedule impact for

each major reason category. This method also served to identify the major areas of change and to present a feel for the total magnitude of the changes.

The second analysis compared change order sensitivities for different types of projects. The sensitivities were determined from the cost and time effect of change orders on original project cost and contract schedule and were plotted as a ratio. High sensitivity rates indicated a high effect. A plot of the actual completion period with respect to the original contract period for most projects was also plotted to compare with the contract schedule sensitivity. A negative ratio indicated that the project was completed within the original contract time regardless of time extensions. Averages were calculated for each group to obtain average cost or change order rates and average contract schedule impact rates.

Each project was assigned to a project group based on the likelihood of encountering similar type changes as the other projects in that group. For example, a ball field upgrade project was included in a civil repair project group along with projects to repair runways and storm sewers because the projects all involved digging and grading. An alternative to this method was considered and involved grouping the projects into respective functional categories, i.e., recreation, airfield, and utilities for this case. This method would have resulted in weak data sampling for each group and the results would have had no significance. The projects types chosen were (1) civil repair projects, (2) new construction projects, (3) electrical distribution

upgrades, (4) environmental remediation projects, (5) HVAC projects, (6) building renovations, and (7) miscellaneous repair projects. The civil projects included repairs to runways, piers, and storm sewers. New construction projects involved various new facilities built from the ground up. Electrical distribution projects were made up of a significant airfield lighting project and primary distribution upgrade. Environmental projects involved the removal of underground storage tanks and contaminated soil. HVAC projects involved the replacement of HVAC equipment and controls. Building renovation projects involved the repair, replacement, or remodeling of significant building components. Repair projects involved miscellaneous repairs to foundations, structures, and tanks and included asbestos removal projects.

A final analysis of some individual change orders was included to demonstrate the process and logic used to categorize the various change orders. Although the Navy had already categorized the changes by source, it was felt that an independent analysis was required to standardize the method used to categorize the changes. This measure was not intended to second guess the conclusions of the contracting officer or contract administrator since there could invariably be other more important issues not discovered in the file which might form a legal basis for a change. Nevertheless, the process served to verify the conclusions reached by the responsible parties in most cases. A comparison of the categorizations made by the Navy and those made in this report can be seen in the appendix.

CHAPTER 4

ANALYSIS OF DATA

4.1 INTRODUCTION

The data set involved a total of 157 modifications from 58 construction contracts totalling $32,604,224. The first data analysis shows the total cost and time extension impact of all changes for the different reason categories for change orders. The relative percentages of total change order cost and time extensions can be seen in the figures. The second analysis shows the impact of changes for each project type. A separate section is included for each project type. Tables are used to summarize the data and bar charts are included to analyze the projects within each group to observe averages of change order sensitivities and award amounts. Comparisons between the effect on contract extension and actual contract completion relative to the original contract completion date can also be seen for the projects for which data was available. A list of every project by project type can be seen in the appendix as a point of reference. A section which demonstrates the process used to categorize some of the change orders is included and a concluding section summarizes the results and shows additional results obtained by using an alternative method to calculate average sensitivities. The results obtained from both methods yielded the same conclusions.

4.2 TOTAL COST AND SCHEDULE EFFECT OF CHANGE ORDERS

Figures 4-1 and 4-2 show the total cost and time extensions attributed to the change orders researched. The total cost was approximately $2,700,000 or 8.3% of total awards and the total time extended was 6015 calendar days. As can be seen in the figures, there was good correlation between additional cost and time totals with the exception of delay and improved information. The effect on schedule for owner changes also appears disproportionately higher than the effect on cost. The delays encountered in this study were almost entirely noncompensable or excusable weather delays. Changes related to improved information provided very little cost benefit but resulted in time extensions in all cases.

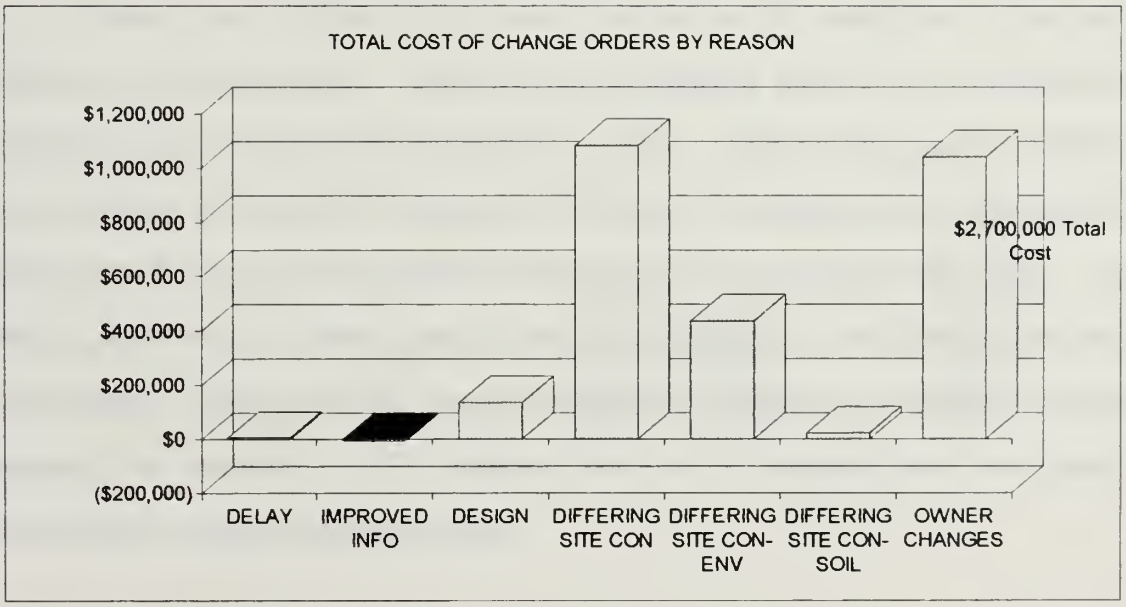


Figure 4-1: Total Cost of Change Orders by Reason

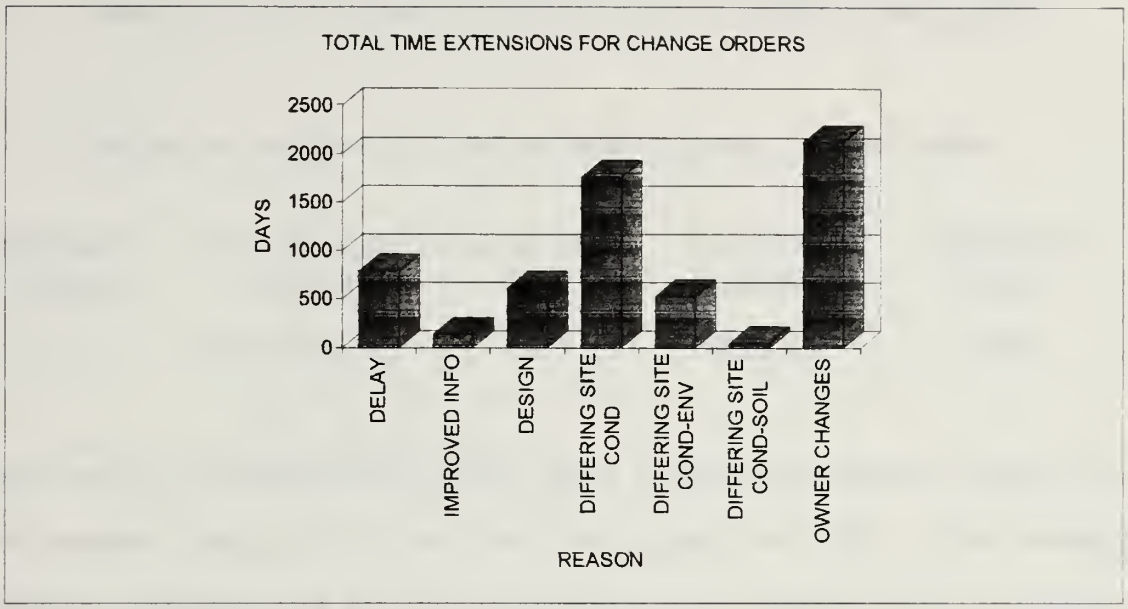


Figure 4-2: Total Time Extensions due to Change Orders

Differing site conditions and owner changes led all categories in cost with 40% and 38% respectively. Differing site conditions related to environmental remediation projects were less substantial at 16%. Design changes and differing site conditions for soil were minimal at 5% and 1% respectively. The highest percentage of time extensions were attributed to owner changes with 36%. This effect is even more dramatic considering that 13% of the total time extensions were delays. The effect of owner changes on contract completion periods resulted in an increase of 2165 calendar days or 35 calendar days per project with respect to original contract period.

4.3 CHANGE ORDER SENSITIVITIES FOR CIVIL REPAIR PROJECTS

The data set summary for the civil repair projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
9	$4,026,627	1590	$450,377	365

The change order sensitivities for civil repair projects are shown on Figure 4-3. The average change order cost rate per project was 16%. The average completion schedule rate increase was 28% but the average actual completion rate was -4.0% to indicate that on the average, time extensions did not cause delays beyond the original completion date. Figure 4-4 shows the relative impact by reason categories. Latent conditions and owner changes were the predominant categories. The major cause of the latent conditions was buried utilities on contract 929017, Repairs to Storm Sewer and the major cause for owner changes was due to work on additional runway sections on contract 919010, Repair Taxiways at NAS. It should be noted that sensitivity rates for these relatively high value projects were low. The leading cause for delays was nonaccessability to site on contracts 889007, Upgrades to Ball Park and 929045, Repairs to Small Berthing Pier. Contract schedule sensitivity was high for these projects.

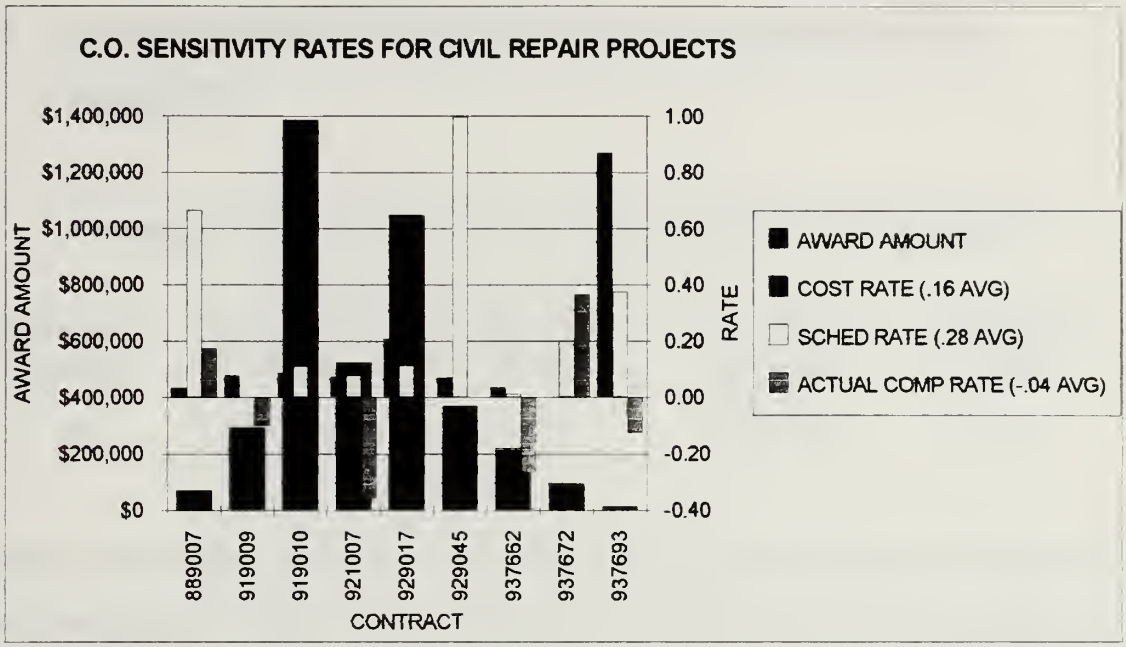


Figure 4-3: Sensitivity Rates For Civil Repair Projects

REASON FOR CHANGE	*COST OF CHANGES*	*ADDITIONAL CONTRACT DAYS*	*% OF TOTAL GROUP COST*	*% OF TOTAL ADDITIONAL DAYS*
DELAY	$0	149	0%	41%
DESIGN	$748	21	0%	6%
LATENT COND	$246,873	86	55%	24%
LATENT COND-SOILS	$14,179	5	3%	1%
OWNER	$188,577	104	42%	28%
TOTAL	$450,377	365		

Figure 4-4: Percentage of Change Order Cost and Time Extensions, Civil Repair Projects

4.4 CHANGE ORDER SENSITIVITIES FOR NEW CONSTRUCTION PROJECTS

The data set summary for new construction projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
10	$9,873,796	3360	$286,153	641

Change order sensitivities for new construction projects are shown on Figure 4-5. The average cost rate for these projects was considerably lower as was to be expected at 8%. It should be noted that some Navy activities consider 6% as a reasonable change order rate for new construction. The completion schedule rate remained high at 24%. There appears to be an anomoly on the average actual completion rate due to incomplete data. The relatively high schedule rate might be attributed to unreasonable contract completion periods required in specifications. Relatively higher sensitivities were evident on the lower priced projects.

Figure 4-6 shows the percentage of change order cost and schedule by reason. Owner changes were predominant at 67% and 33% respectively suggesting high owner involvement in new construction projects.

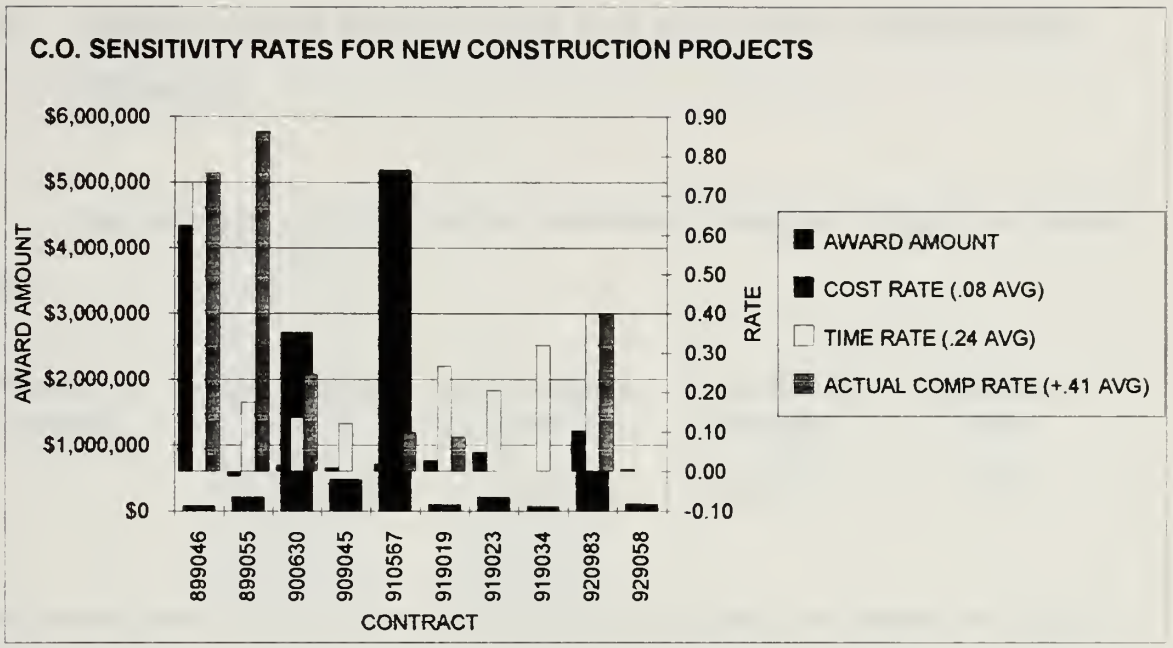


Figure 4-5: Sensitivity Rates for New Construction Projects

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	148	0%	23%
DESIGN	$20,127	47	7%	7%
IMPROVED INFORMATION	($492)	0	0%	0%
LATENT COND	$21,179	131	7%	20%
LATENT COND-ENVIR	$51,671	88	18%	14%
LATENT COND-SOILS	$3,044	15	1%	2%
OWNER	$190,624	212	67%	33%
TOTAL	$286,153	641		

Figure 4-6: Percentage of Change Order Cost and Time Extensions, New Construction Projects

4.5 CHANGE ORDER SENSITIVITIES FOR ELECTRICAL DISTRIBUTION UPGRADES

The data set summary for the electrical distribution projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
2	$4,768,583	1200	$194,423	337

The sensitivities for the two electrical distribution projects are shown on Figure 4-7. The cost and schedule rates were comparable to the new construction projects at 6% and 28% respectively. The low cost sensitivity was to be expected since these types of projects are relatively high cost and have a well defined scope. The higher schedule rate suggests that the original completion period was unreasonable as was the case for new construction. This is substantiated by the lack of excusable delays for these projects.

Figure 4-8 shows that owner changes were the leading cause of change order cost. This might seem unusual but is explained by the fact that the scope of project 910413, Primary Distribution Upgrade was expanded to include several additional transformer stations at the request of the station. There also appears to be a higher than normal percentage of design changes due to design errors on project 870016, Airfield Lighting Upgrade.

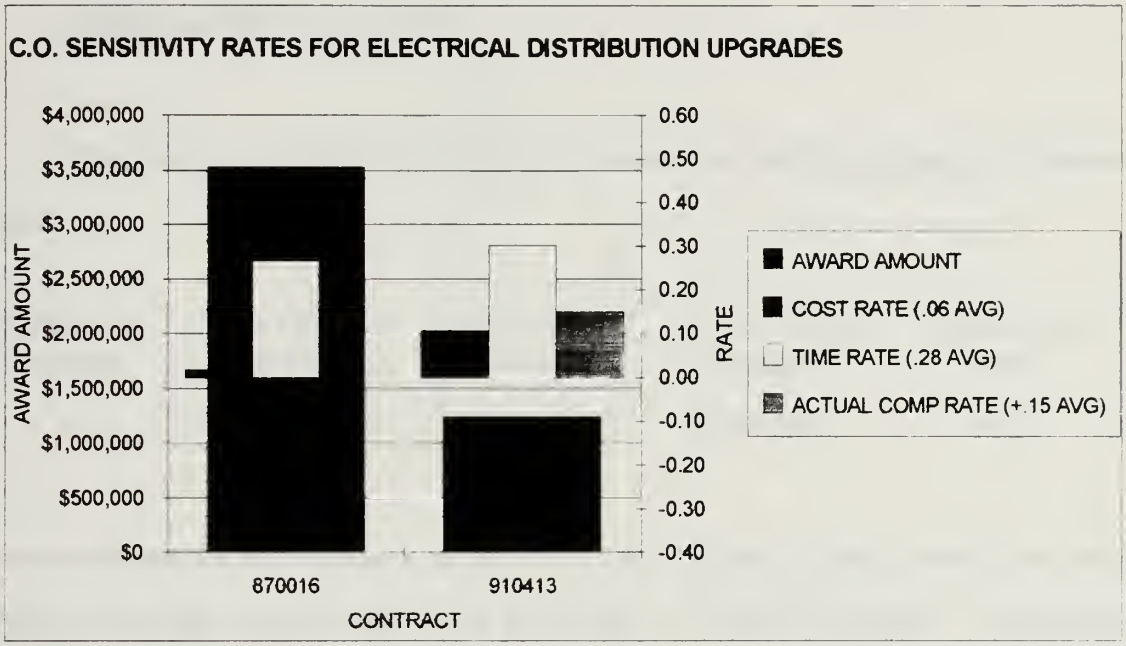


Figure 4-7: Change Order Sensitivities For Electrical Distribution Upgrades

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DESIGN	$63,013	192	32%	57%
LATENT COND	$49,749	98	26%	29%
OWNER	$81,661	47	42%	14%
TOTAL	$194,423	337		

Figure 4-8: Percentage of Change Order Cost and Time Extensions, Electrical Distribution Upgrades

4.6 CHANGE ORDER SENSITIVITIES FOR ENVIRONMENTAL REMEDIATION PROJECTS

The data set summary for the environmental remediation projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
4	$1,390,623	1020	$406,942	892

The environmental remediation projects had the highest change order cost and contract schedule sensitivities of all the types of projects studied. Substantial differing environmental site conditions were encountered on all projects caused mostly by the presence of contaminated soil. Delays and time extensions were also rampant on all projects with an average contract sensitivity rate of 90% and an actual average delay rate of 183%. Owner changes caused by extending the scope of the remediation to include other areas made up 5% of the total change order cost but increased the contract period by 34%. Figures 4-9 and 4-10 show the sensitivities and percentages by reason respectively.

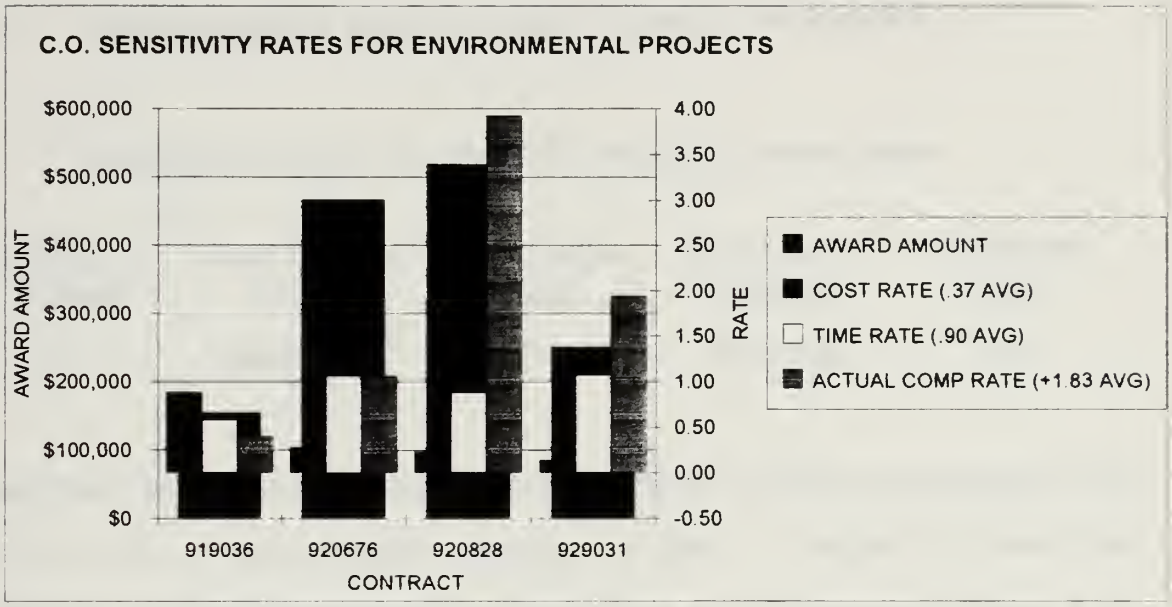
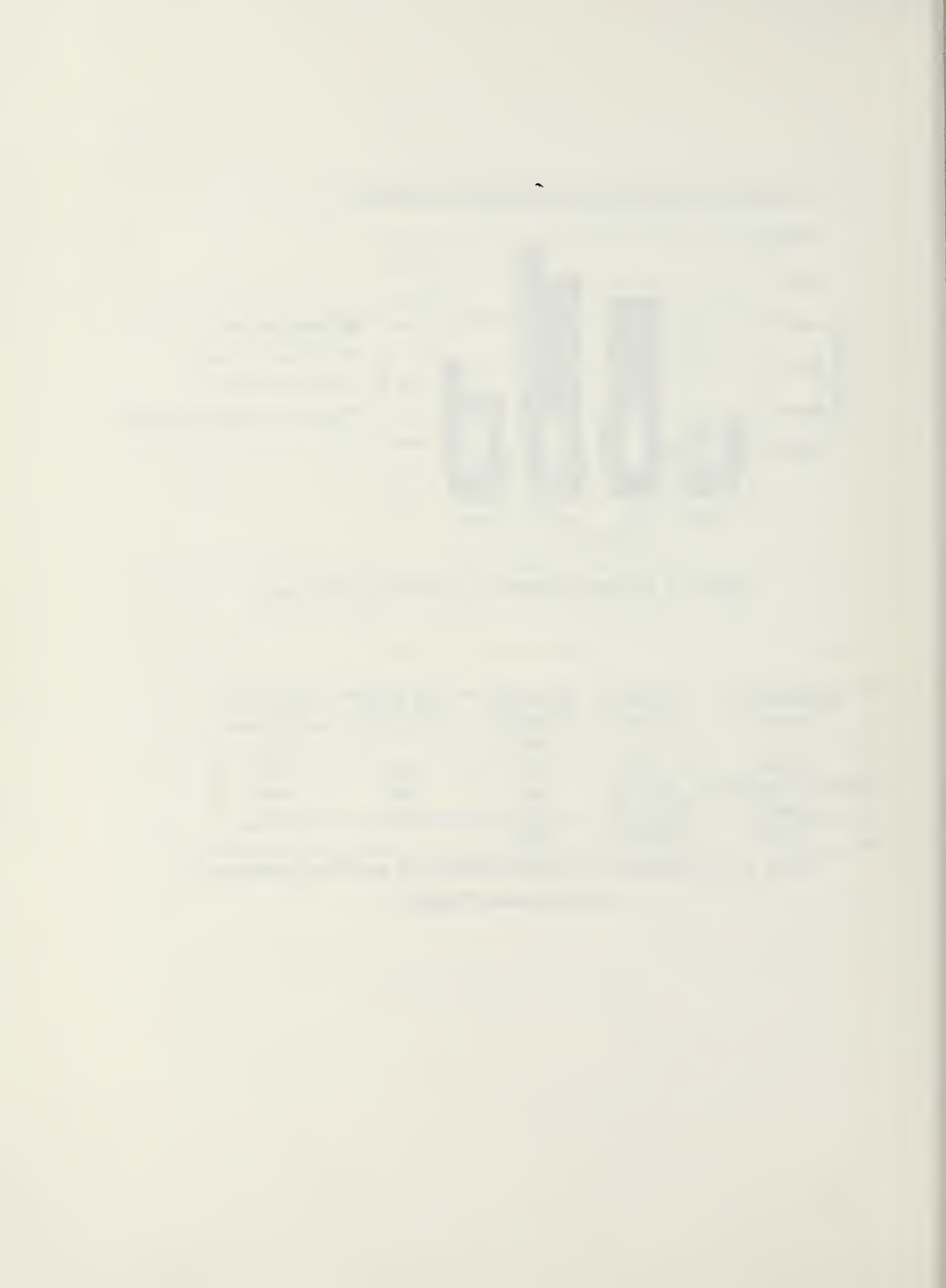


Figure 4-9: Sensitivity Rates For Environmental Projects

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	147	0%	16%
LATENT COND-ENVIR	$384,809	443	95%	50%
OWNER	$22,133	302	5%	34%
TOTAL	$406,942	892		

Figure 4-10: Percentage of Change Order Cost and Time Extensions, Environmental Projects



4.7 CHANGE ORDER SENSITIVITIES FOR HVAC PROJECTS

The data set summary for the HVAC projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
8	$2,418,593	2070	$321,135	843

The HVAC projects investigated showed a moderate average cost sensitivity rate of 10% and a high schedule sensitivity of 36%. It should be noted that sensitivities varied significantly on all the projects as can be seen on Figure 4-11. Figure 4-12 demonstrates that owner changes were once again the leading category of changes making up 53% and 25% of the total change order cost and time extension respectively. The leading cause of these changes involved replacing HVAC equipment not identified for replacement in the contract. Differing site conditions were also prevalent at 41% and 25% of total change order cost and time extension respectively.

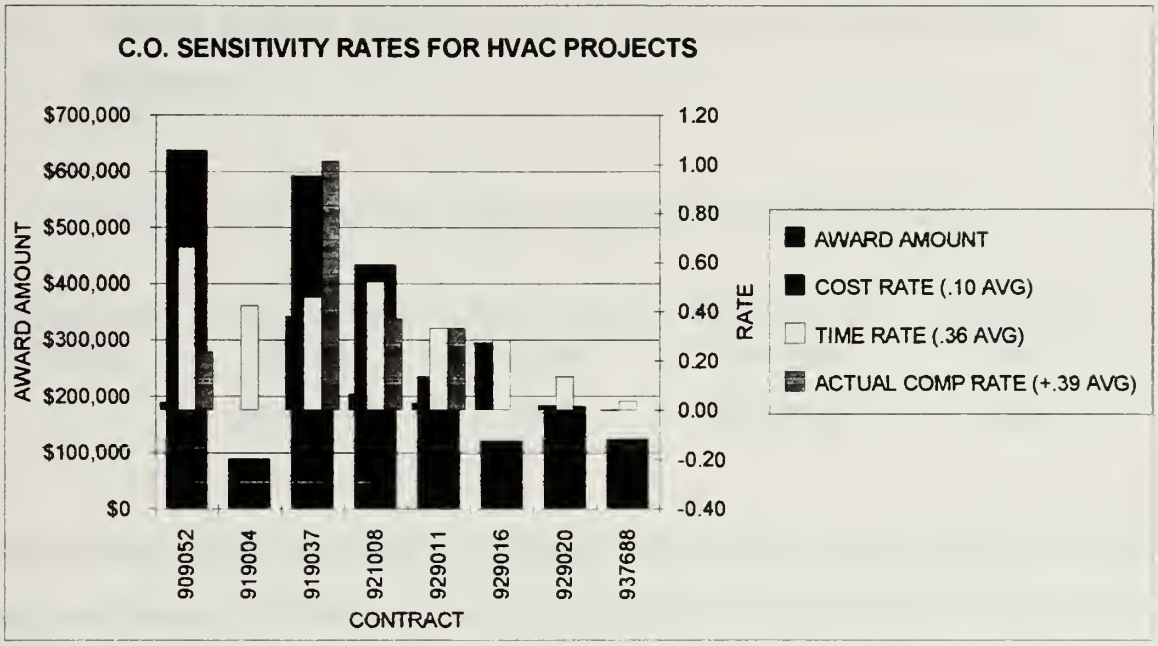


Figure 4-11: Sensitivity Rates For HVAC Projects

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	183	0%	22%
DESIGN	$21,799	100	7%	12%
IMPROVED INFORMATION	($856)	139	0%	16%
LATENT COND	$131,581	209	41%	25%
OWNER	$168,611	212	53%	25%
TOTAL	$321,135	843		

Figure 4-12: Percentage of Change Order Cost and Time Extensions, HVAC Projects

4.8 CHANGE ORDER SENSITIVITIES FOR BUILDING RENOVATION PROJECTS

The data set summary for building renovations is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
21	$9,528,164	4680	$596,439	1885

The building renovation projects comprised the majority of the sampling for this study and made up the largest total change order cost at $596,439. Figures 4-13 and 4-14 show the sensitivities and percentages of changes by categories. The average change order cost rate was 12% with an average contract extension of 41%. The actual completion rate was also 41%. As with the HVAC projects, owner changes and differing site conditions were the predominant reasons for change comprising 54% and 40% of the total change order cost respectively.

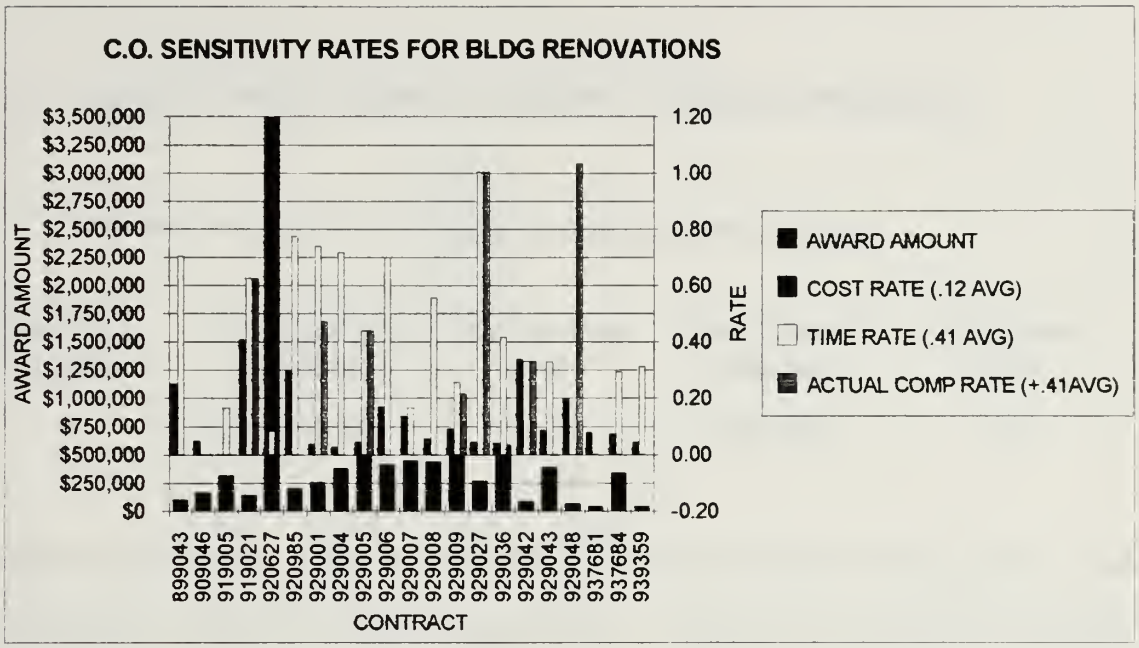


Figure 4-13: Sensitivity Rates For Building Renovations

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$6,000	138	1%	7%
DESIGN	$29,947	253	5%	13%
IMPROVED INFORMATION	($235)	0	0%	0%
LATENT COND	$239,574	835	40%	44%
OWNER	$321,153	659	54%	35%
TOTAL	$596,439	1885		

Figure 4-14: Percentage of Change Order Cost and Time Extensions, Building Renovations

4.9 CHANGE ORDER SENSITIVITIES FOR REPAIR PROJECTS

The data set summary for repair projects is shown below.

Number of Projects	Total Contract Amount	Total Contract Days	Total Cost of Changes	Total Extra Days
4	$597,838	840	$394,226	434

Sensitivities for repair projects were high at 48% and 53% for change order cost and contract schedule increase respectively. It should be noted that asbestos removal was included in this project category and was the significant cause for the changes. Figures 4-15 and 4-16 show the sensitivities and percentages of cost and schedule increase. As indicated on Figure 4-16, Latent conditions caused by the presence of unforeseen asbestos on contract 919022, Remove Asbestos Pipe Insulation was the predominant cause of the changes for this project category.

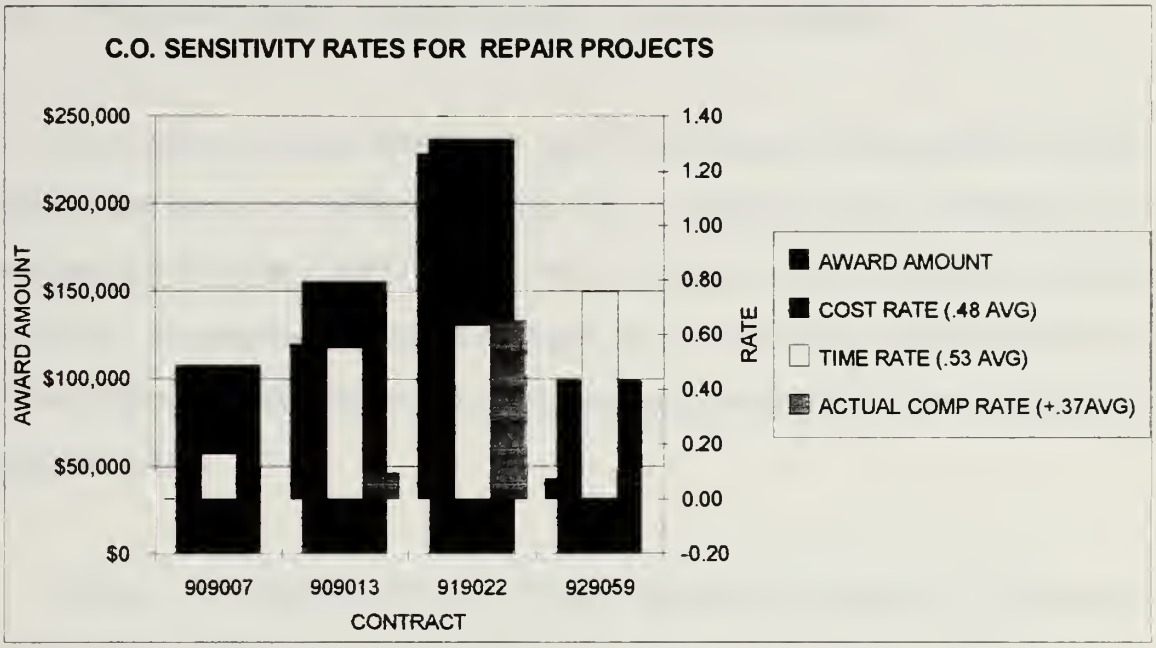


Figure 4-15: Sensitivity Rates For Repair Projects

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
IMPROVED INFORMATION	($5,099)	0	-1%	0%
LATENT COND	$394,098	404	100%	93%
LATENT COND-SOILS	$5,227	30	1%	7%
TOTAL	$394,226	434		

Figure 4-16: Percentage of Change Order Cost and Time Extensions, Repair Projects

4.10 PROCESS USED TO CATEGORIZE CHANGE ORDERS

The various reason categories used in this study were similar to those used by the Navy in modification write ups. Typically, latent or differing site conditions are listed as "UNFO" or unforeseen changes, owner changes are listed as "CREQ", or customer requested changes, etc. This section will describe some of the modifications included in this study and will address how reason categories were determined.

Case 1: In Contract 910413, Primary Distribution Upgrade, modification wording was as follows:

> The contractor shall provide all labor, equipment, materials, and supervision necessary to accomplish the following: (1) Install (9) 75 KVA pad mounted transformers and secondary feeders as indicated in sketches (1) and (2).

This was viewed as an owner change because of significant expanded scope of work. In addition, design errors were not indicated in the write up and latent conditions did not apply.

Case 2: In contract 919010, Repair Taxiways, modification justification was as follows:

> Taxiway echo between the parallel runways is failing due to the heavy load imposed on it from P3 and C5 aircraft. This taxiway needs to be reconstructed from the subbase up. Presently it is closed to large aircraft to prevent further damage to the taxiway and reduce FOD to aircraft. AIROPS has requested this section of taxiway to be reconstructed.

Although the modification write up indicated this change order to be unforeseen, the circumstances behind the change appear to make this an owner requested change. It is likely the Navy knew the condition of this section of taxiway prior to awarding the contract for a different section. Nor can a visible taxiway be viewed as a hidden site condition.

Case 3: Contract 929006, Repairs to Hangar 55, justification wording is as follows:

> The customer has requested that four roof top A/C units be replaced due to their age and deterioration. At least one is now permanently down and it is unknown just how long the other three will remain in operation. As the hottest months of the summer fast approach Corpus Christi, it is highly desireable to replace these A/C units promptly.

This change order was also listed as an unforeseen change in the file. However, it was listed as an owner requested change in this study because of the fact that the customer specifically requested the change and the A/C units were not hidden and a reasonable investigation would have discovered that the units needed to be replaced. This is not to say that the units should not have been replaced with a properly executed modification.

Case 4: Contract 921007, Civil Repairs and Improvements, U.S. Coast Guard, purpose wording is as follows:

> The contractor requires the road base to be a modified base material consisting of the existing bituminous surface mixed with a portion of the existing granular base course, then reshaped and compacted to the lines and grades specified. An area of the road measuring approximately 325' x 28', located

> between the Boathouse and the Exchange, cannot be sufficiently rolled and compacted to meet the 100% compaction (or even 95%) using the modified proctor test method. The existing base material is dredge spoil from the bay.

The reason code used for this modification was unforeseen and latent conditions - soil was applied accordingly in this study.

Unfortunately, not all of the change orders were as straightforward as cases 1-4. The following is an example of a more complicated case. In contract 929059, Paint Fuel Tanks, the project file reveals:

> The contractor has submitted a request for equitable adjustment for an extra coat of paint that he applied to the fuel tanks. The reason he was required by the government to apply an additional coat of paint was because the intermediate coat of paint bled through the top coat and left the tanks looking decidedly splotchy. The contractor's position is that he used paint that had been approved by the government, he applied the proper thickness of paint (7 mils) as required, and that any bleed through was due to poor design. The government's position is that the contract called for a light gray intermediate coat, and the contractor used a light peach color. The government allowed the contractor to select the color he wanted to use, since he is a professional painter and should have known what would cover well and what wouldn't. Since the contract did specifically call for a light gray intermediate coat, and the contractor did not use a light gray intermediate coat, the government is not liable for the intermediate coat bleeding through the top coat.

In this case, the government acknowledged a constructive change because the inspector had directed an additional coat of paint be applied. However, the fact that the contractor was responsible for applying the correct coat of paint did not relieve him of total responsibility. An agreement was reached to extend the contract period 91 calendar days with no compensation for the additional coat of paint. The change was categorized as a delay in this study.

Case 6: On Contract 929004, Repairs to Hangar 41, the purpose wording reads:

> The contractor has requested a time-only modification to the contract. The reason given for eighteen (18) of the total fifty (50) days requested is inclement weather. Fifteen (15) days are requested for waiting for a final inspection which is not a valid reason for a time extension. The remaining days are due to what the contractor states was a stoppage at the government's request to install the interior door and exterior storefront. This is not a true statement. It was not requested that the contractor stop work, and it should be noted that the contractor received a time extension of 45 days on the doors modification. What the contractor does not mention, however, is that the Public Works Environmental office stopped the contractor on the premise that lead paint chips on the exterior of the hangar were being released without proper containment. The work was stopped for 5 days, at which time the report on a paint sample taken stated no lead content. The lead abatement submittal, which was approved, made no reference to lead paint on the exterior surfaces. Also, a change of command around August 1993 affected the contractor's operations by at least 1 day. Therefore, in review of the contractor's request (18 days of which are justified), and consideration for approximately 6 days of government caused delays, propose that this request be approved for a 24 day time extension.

This change was viewed as an excusable delay in this study.

4.11 SUMMARY OF DATA ANALYSIS

Figure 4-17 gives a summary of the change order sensitivities and predominant reasons for change orders presented in this chapter. Figure 4-18 shows a comparison of the average change order sensitivities (calculated by averaging rates for each contract) versus the average change order sensitivities (calculated by determining the total extra costs and time extensions divided by the total contract amounts and time periods). This comparison is significant because it provides a measure of the effect of variation between different

amounts and contract periods. The averages obtained by using the latter method were lower than the former except for the HVAC projects but the differences between the relativity of the averages for the project types was not significant (i.e., new construction and electrical distribution projects showed the lowest sensitivities and environmental and miscellaneous repair projects showed the highest sensitivities using both methods). Hence, the conclusions reached in this report would have been the same if the latter method had been used to obtain the results.

PROJECT TYPE	*AVERAGE CHANGE ORDER RATE*	*AVERAGE TIME EXTENSION RATE*	*PREDOMINANT REASONS FOR CHANGE*
CIVIL REPAIR PROJECTS	16%	28%	LATENT CONDITIONS, OWNER CHANGES
NEW CONSTRUCTION PROJECTS	8%	24%	OWNER CHANGES, LATENT COND-ENVIR DELAYS
ELECTRICAL DISTRIBUTION UPGRADES	6%	28%	OWNER CHANGES, DESIGN, LATENT CONDITIONS
ENVIRONMENTAL REMEDIATION PROJECTS	37%	90%	LATENT COND-ENVIR OWNER CHANGES
HVAC PROJECTS	10%	36%	OWNER CHANGES, LATENT CONDITIONS, DELAYS
BUILDING RENOVATIONS	12%	41%	OWNER CHANGES, LATENT CONDITIONS
MISC. REPAIR PROJECTS	48%	53%	LATENT CONDITIONS

Figure 4-17: Summary of Sensitivities and Predominant Change Categories

PROJECT TYPE	*AVERAGE CHANGE ORDER RATE (BY AVERAGING PROJECT RATES)*	*AVERAGE CHANGE ORDER RATE (BY AVERAGING TOTAL COSTS)*	*AVERAGE TIME EXTENSION RATE (BY AVERAGING PROJECT RATES)*	*AVERAGE TIME EXTENSION RATE (BY AVERAGING TOTAL TIME EXTENSIONS)*
CIVIL REPAIR PROJECTS	16%	11%	28%	23%
NEW CONSTRUCTION PROJECTS	8%	2.9%	24%	19%
ELECTRICAL DISTRIBUTION UPGRADES	6%	4.1%	28%	28%
ENVIRONMENTAL REMEDIATION PROJECTS	37%	29%	90%	87%
HVAC PROJECTS	10%	13%	36%	41%
BUILDING RENOVATIONS	12%	6.3%	41%	40%
MISC. REPAIR PROJECTS	48%	66%	53%	52%

Figure 4-18: Comparison of Sensitivities by Using Two Methods

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The following conclusions were reached as a result of the data analysis presented in chapter 4.

1. Owner changes to include increases in scope of work were the predominant source of change orders for new construction projects (67% cost), electrical distribution upgrades (42% cost), HVAC projects (53% cost), and building renovations (54% cost) and were significant causes of change orders for civil repair (42% cost) and environmental remediation (34% schedule) projects. The average increase in contract schedule due to owner changes was 35 calendar days per project.

2. Average change order cost rates varied by type of project and were lowest for electrical distribution (6%) and new construction projects (8%); moderate for HVAC projects (10%), building renovations (12%), and civil repair projects (16%); and highest for environmental remediation (37%) and miscellaneous repair projects including asbestos removal (48%).

3. Average contract time extension rates ranged from 24% for new construction projects to 90% for environmental remediation projects. The

average actual completion period with respect to original for all of the project types was comparable to the average time extension rates except for civil repair projects and environmental remediation projects which showed average completion rates of -4.0% and 183% with respect to original contract completion period.

4. The net effect of owner changes on time extensions is disproportionately higher than the net effect on additional cost.

5. Excusable and noncompensable delays were the predominant source for time extensions on civil repair projects (41%) and were significant on new construction (23%), HVAC (22%), environmental remediation (16%) , and building renovation projects (7%).

6. Change orders caused by design errors comprised only 5% of the total cost of change orders and 10% of the total time extended.

7. In general, the higher the award amount for a particular project, the lower the change order sensitivities and vice versa.

5.2 RECOMMENDATIONS BASED ON RESEARCH

This research has provided sufficient data to recommend that the Navy put more emphasis on owner changes if it desires to reduce change orders on

future construction contracts. However, it is not clear if reducing owner changes is necessarily good for the Navy. The conventional wisdom in favor of owner changes is that they give contracting officers the flexibility to make changes to the work to provide greater customer satisfaction and expend available funds. Other perceived advantages of owner changes are reduced mobilization, equipment, and overhead costs for certain additive work, reduced administrative effort compared to having to prepare additional contracts for the additive work, and the belief that changes in the work affect only the work in the changed area and hence have little impact on a contractor's progress. Arguments against owner changes include loss of productivity and efficiency of contractor crews, loss of momentum, ripple effect, and negative morale aspects.[12] This study has also shown that there is a disproportionately higher effect on time extensions relative to additional cost as a result of owner changes.

A second recommendation based on this study is to place special emphasis on investigating information related to site conditions during design. A checklist similar to that included in chapter 2 could be employed by activities as a design review measure.

A third recommendation is to avoid firm fixed price contracting for environmental remediation and asbestos removal projects. The cost and

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[12] Borcherding, John D., "Improving Productivity in Industrial Construction", Journal of the Construction Division, Proceedings of the American Society of Civil Engineers, Vol. 102, No. Co4, December 1976.

schedule sensitivities for these types of contracts do not appear to justify firm fixed pricing and the administrative effort involved in handling related change orders appears to be excessive.

Another recommendation based on observation of the data for the various time extensions granted is to expand completion periods specified for contracts. This measure might reduce the administrative effort involved in modifying contracts to extend completion dates for excusable delays.

A final recommendation is for financial claimants and customers to provide the ROICC with change order contingencies similar to those determined for the various project types in this study when providing funds for awarded contracts. This measure would expedite processing of change orders, minimize delays, and give the contracting officer more authority in the execution of changed work.

5.3 RECOMMENDATIONS FOR FUTURE RESEARCH

There are few documented studies which identify and evaluate the specific sources and impacts of changes. One such study conducted in the southeastern United States reported changes in scope or owner changes to be the leading source of changes with 40.4% frequency and differing site

conditions to be the second leading source with 20.7% frequency.[13] The results are comparable to those found in this study.

A recommended topic for future reasearch would be to study the impact of owner changes in more detail to compare the advantages and disadvantages derived by these changes. Factors to be considered in such a study might include the positive impact of owner changes on customer satisfaction versus the negative impact of delays in contract completion. Similar studies to those presented in this report could also be repeated at other activities and different parts of the country to verify or contradict the findings presented.

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[13] Rowland, Henry J., "The Causes and Effects of Change Orders on the Construction Process", Masters Thesis, Georgia Institute of Technology, 1981.

APPENDIX

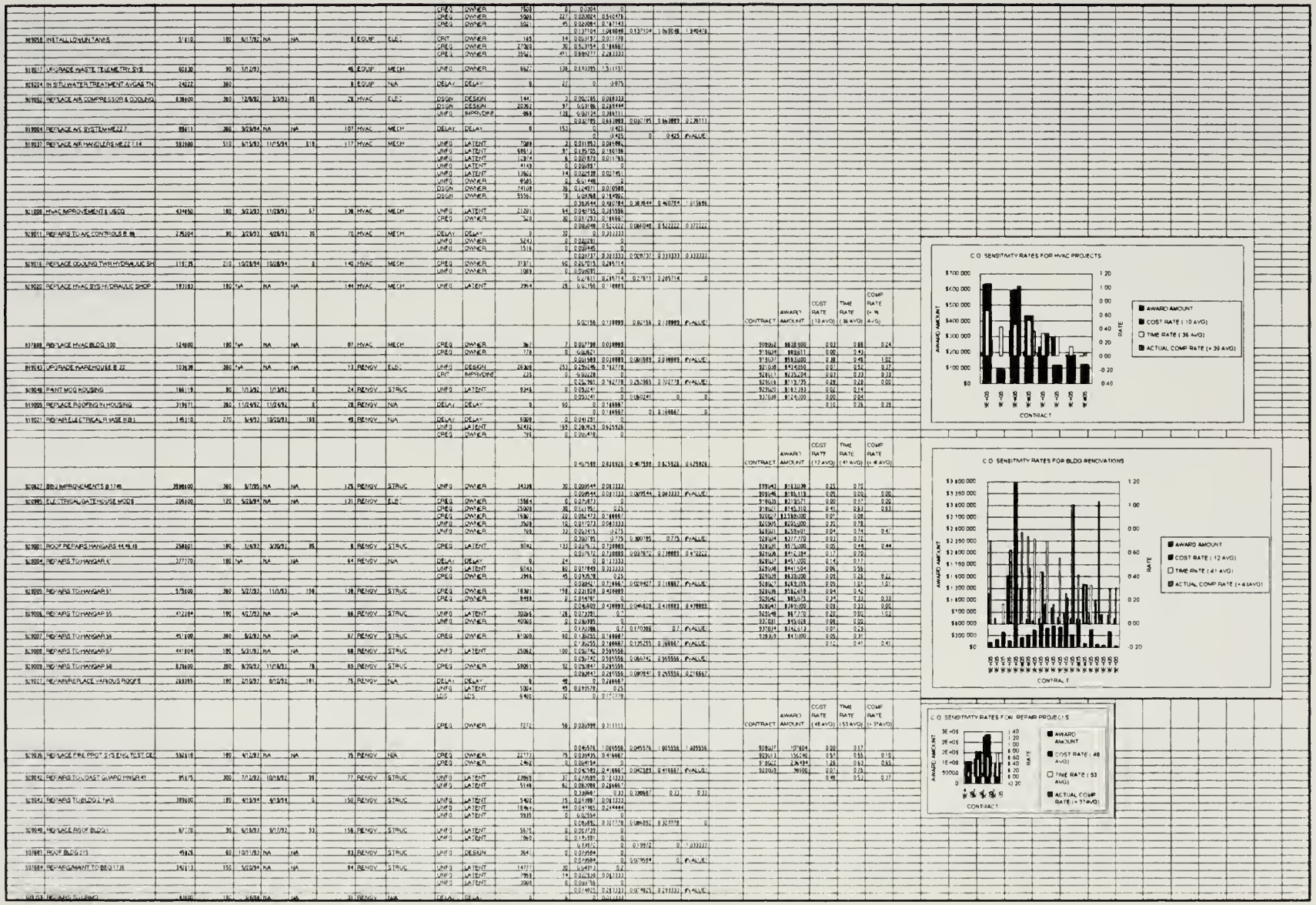
The appendix includes the three Excel spreadsheets with supporting data used to generate the charts and tables in the Data Analysis section of this report. To copy, print, or modify a chart, open the applicable spreadsheet file included on the floppy disk with .XLS extension and click on the desired chart. To revise data or create a chart with unique data, simply replace the data listed on the columns adjacent to each chart with the desired data.

Any chapter of this thesis can be copied or reproduced by opening the desired chapter file on the floppy disk with .DOC extension in Microsoft Word for Windows format.

CONTRACT NUMBER	PROJECT	AWARD AMT	ORIGINAL CONTRACT PERIOD	CHANGE ORDER NO	PROJECT TYPE	ENGINEERING DISCIPLINE	NAVY REASON CODE	ASSIGNED CODE	CHANGE ORDER AMT	TIME EXTENSION
889007	UPGRADE BALL PARK	72555	120	39	CIVIL	N/A	DELAY	DELAY	0	50
889007	UPGRADE BALL PARK	72555	120	37	CIVIL	CIVIL	UNFO	DESIGN	748	3
889007	UPGRADE BALL PARK	72555	120	38	CIVIL	CIVIL	DSGN	LATENT	3764	6
889007	UPGRADE BALL PARK	72555	120	40	CIVIL	N/A	LDS	LDS	-2100	21
919009	REPAIR RUNWAYS 13R,13L,31R,31L	293000	90	45	CIVIL	CIVIL	CREO	OWNER	22348	0
919010	REPAIR TAXIWAYS NAS	1387339	270	108	CIVIL	CIVIL	UNFO	OWNER	120971	30
921007	CIVIL RPRS IMPRVTS U S COAST GUARI	525000	360	60	CIVIL	CIVIL	UNFO	LATENTSO	896	0
921007	CIVIL RPRS IMPRVTS U S COAST GUARI	525000	360	61	CIVIL	CIVIL	UNFO	LATENTSO	13283	5
921007	CIVIL RPRS IMPRVTS U S COAST GUARI	525000	360	59	CIVIL	CIVIL	CREQ	OWNER	24058	23
929017	REPAIRS TO STORM SEWER	1049279	300	142	CIVIL	CIVIL	UNFO	LATENT	155176	34
929017	REPAIRS TO STORM SEWER	1049279	300	143	CIVIL	CIVIL	UNFO	LATENT	61800	0
929045	REPAIR SMALL BERTHING PIER	370000	150	155	CIVIL	N/A	DELAY	DELAY	0	99
929045	REPAIR SMALL BERTHING PIER	370000	150	153	CIVIL	CIVIL	UNFO	LATENT	19798	46
929045	REPAIR SMALL BERTHING PIER	370000	150	154	CIVIL	CIVIL	CREO	OWNER	6813	5
937662	PAVE ACCESS ROAD ADJACENT TP B 1	217604	90	80	CIVIL	CIVIL	UNFO	LATENT	6335	0
937662	PAVE ACCESS ROAD ADJACENT TP B 1	217604	90	81	CIVIL	CIVIL	CREO	OWNER	1469	1
937672	PAVE RUNNING TRACK	97000	90	82	CIVIL	CIVIL	DSGN	DESIGN	0	18
937693	SEAL CRACKS ALONG RUNWAYS	14850	120	89	CIVIL	CIVIL	UNFO	OWNER	12918	45
899046	DEMOLISH HOUSING UNITS	82750	120	14	CONST	CIVIL	UNFO	LATENTEN	36711	88
899046	DEMOLISH HOUSING UNITS	82750	120	15	CONST	CIVIL	UNFO	LATENTEN	12960	0
899055	CONSTRUCT RADIOACTIVE STORAGE E	216900	360	95	CONST	ELEC	DSGN	DESIGN	2353	3
899055	CONSTRUCT RADIOACTIVE STORAGE E	216900	360	96	CONST	CIVIL	CREQ	OWNER	-4986	0
899055	CONSTRUCT RADIOACTIVE STORAGE E	216900	360	94	CONST	CIVIL	CREQ	OWNER	0	60
900630	ENGINEERING ANALYSIS FACILITY	2717640	480	98	CONST	ELEC	CRIT	LDS	-203	0
900630	ENGINEERING ANALYSIS FACILITY	2717640	480	97	CONST	ELEC	CREQ	OWNER	7025	21
900630	ENGINEERING ANALYSIS FACILITY	2717640	480	99	CONST	ELEC	CREQ	OWNER	39542	45
909045	CONST DELUGE RINSE FACILITY	487000	360	21	CONST	N/A	UNFO	DELAY	0	7
909045	CONST DELUGE RINSE FACILITY	487000	360	23	CONST	N/A	UNFO	DELAY	0	35
909045	CONST DELUGE RINSE FACILITY	487000	360	20	CONST	ELEC	CREQ	OWNER	528	2
909045	CONST DELUGE RINSE FACILITY	487000	360	22	CONST	ELEC	UNFO	OWNER	4205	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	103	CONST	ELEC	DSGN	DESIGN	1598	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	105	CONST	MECH	CRIT	DESIGN	730	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	100	CONST	ELEC	UNFO	IMPRVDINF	-492	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	106	CONST	CIVIL	UNFO	LATENT	-1400	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	101	CONST	STRUC	CREQ	OWNER	2617	2
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	102	CONST	STRUC	CREO	OWNER	4810	0
910567	AIRCRAFT INST REPAIR/CALIB FACILITY	5191000	630	104	CONST	ELEC	DSGN	OWNER	94144	0
919019	INSTALL FLIGHTLINE FENCE	100186	240	109	CONST	N/A	DELAY	DELAY	0	37
919019	INSTALL FLIGHTLINE FENCE	100186	240	110	CONST	N/A	DELAY	DELAY	0	21
919019	INSTALL FLIGHTLINE FENCE	100186	240	111	CONST	CIVIL	UNFO	LATENT	2974	6
919023	CONST PEST CONTROL FACILITY	220781	360	29	CONST	STRUC	DSGN	DESIGN	1283	14
919023	CONST PEST CONTROL FACILITY	220781	360	30	CONST	CIVIL	UNFO	LATENTSO	2429	15
919023	CONST PEST CONTROL FACILITY	220781	360	31	CONST	ELEC	CREQ	OWNER	7286	45
919034	DSGN/CONST BOAT STORAGE BLDGS	79789	150	1	CONST	N/A	UNFO	DELAY	0	48
920983	MSO/WPB SUPPORT FAC USCG	667750	480	126	CONST	STRUC	DSGN	DESIGN	14163	30
920983	MSO/WPB SUPPORT FAC USCG	667750	480	129	CONST	STRUC	UNFO	LATENT	19605	54
920983	MSO/WPB SUPPORT FAC USCG	667750	480	130	CONST	STRUC	UNFO	LATENT	0	71
920983	MSO/WPB SUPPORT FAC USCG	667750	480	127	CONST	STRUC	UNFO	OWNER	14931	7
920983	MSO/WPB SUPPORT FAC USCG	667750	480	128	CONST	STRUC	UNFO	OWNER	20522	30
929056	CONST HAZ WASTE MATERIAL STOR	110000	180	7	CONST	CIVIL	UNFO	LATENTSO	615	0
870016	AIRFIELD LIGHTING UPGRADE NAS	3529000	720	93	ELEC	ELEC	UNFO	DESIGN	63013	192
870016	AIRFIELD LIGHTING UPGRADE NAS	3529000	720	92	ELEC	CIVIL	CREO	OWNER	-405	0
910413	PRIMARY DISTRIBUTION UPGRADE	1239583	480	41	ELEC	ELEC	UNFO	LATENT	11153	0
910413	PRIMARY DISTRIBUTION UPGRADE	1239583	480	42	ELEC	ELEC	UNFO	LATENT	38596	98
910413	PRIMARY DISTRIBUTION UPGRADE	1239583	480	43	ELEC	ELEC	UNFO	OWNER	59957	47
910413	PRIMARY DISTRIBUTION UPGRADE	1239583	480	44	ELEC	ELEC	UNFO	OWNER	22109	0
919036	REMOVAL OF UNDERGND STORAGE TA	154803	360	3	ENVIR	CIVIL	UNFO	LATENTEN	90290	90
919036	REMOVAL OF UNDERGND STORAGE TA	154803	360	4	ENVIR	CIVIL	UNFO	LATENTEN	21612	90
919036	REMOVAL OF UNDERGND STORAGE TA	154803	360	5	ENVIR	CIVIL	UNFO	LATENTEN	19645	0
919036	REMOVAL OF UNDERGND STORAGE TA	154803	360	2	ENVIR	CIVIL	CREO	OWNER	4506	30
920676	JP5 UST REMOVAL BEEVILLE	466989	120	50	ENVIR	CIVIL	CREQ	LATENTEN	74549	120
920676	JP5 UST REMOVAL BEEVILLE	466989	120	51	ENVIR	CIVIL	UNFO	LATENTEN	7329	0
920676	JP5 UST REMOVAL BEEVILLE	466989	120	52	ENVIR	CIVIL	UNFO	LATENTEN	4685	7
920676	JP5 UST REMOVAL BEEVILLE	466989	120	53	ENVIR	CIVIL	UNFO	LATENTEN	31930	0
920676	JP5 UST REMOVAL BEEVILLE	466989	120	54	ENVIR	CIVIL	UNFO	LATENTEN	6960	0
920828	RCRA CORRECTIVE ACTION FOR TANK	518831	120	55	ENVIR	CIVIL	UNFO	LATENTEN	12079	0
920828	RCRA CORRECTIVE ACTION FOR TANK	518831	120	56	ENVIR	CIVIL	UNFO	LATENTEN	37177	0
920828	RCRA CORRECTIVE ACTION FOR TANK	518831	120	57	ENVIR	CIVIL	UNFO	LATENTEN	35550	106
920828	RCRA CORRECTIVE ACTION FOR TANK	518831	120	58	ENVIR	CIVIL	UNFO	LATENTEN	26354	0
929031	REPLACE UST AT FAC 1153	250000	420	149	ENVIR	CIVIL	DELAY	DELAY	0	147
929031	REPLACE UST AT FAC 1153	250000	420	148	ENVIR	CIVIL	UNFO	LATENTEN	16649	30
929031	REPLACE UST AT FAC 1153	250000	420	145	ENVIR	MECH	CREO	OWNER	7600	0
929031	REPLACE UST AT FAC 1153	250000	420	146	ENVIR	CIVIL	CREO	OWNER	5006	227
929031	REPLACE UST AT FAC 1153	250000	420	147	ENVIR	MECH	CREQ	OWNER	5021	45
889058	INSTALL LOX/LIN TANKS	51610	180	9	EQUIP	ELEC	CRIT	OWNER	165	14
889058	INSTALL LOX/LIN TANKS	51610	180	10	EQUIP	CIVIL	CREQ	OWNER	27000	30
889058	INSTALL LOX/LIN TANKS	51610	180	11	EQUIP	STRUC	CREQ	OWNER	35522	411
919017	UPGRADE WASTE TELEMETRY SYS	60030	90	46	EQUIP	MECH	UNFO	OWNER	6627	136
929204	IN SITU WATER TREATMENT AVGAS TN	24222	360	8	EQUIP	N/A	DELAY	DELAY	0	27
909052	REPLACE AIR COMPRESSOR & COOLIN	638800	360	26	HVAC	ELEC	DSGN	DESIGN	1447	3
909052	REPLACE AIR COMPRESSOR & COOLIN	638800	360	27	HVAC	MECH	DSGN	DESIGN	20352	97
909052	REPLACE AIR COMPRESSOR & COOLIN	638800	360	25	HVAC	MECH	UNFO	IMPRVDINF	-856	139
919004	REPLACE A/C SYSTEM MEZZ 7	69611	360	107	HVAC	MECH	DELAY	DELAY	0	153
919037	REPLACE AIR HANDLERS MEZZ 7,14	593000	510	117	HVAC	MECH	UNFO	LATENT	7088	3
919037	REPLACE AIR HANDLERS MEZZ 7,14	593000	510	116	HVAC	CIVIL	UNFO	LATENT	68613	97
919037	REPLACE AIR HANDLERS MEZZ 7,14	593000	510	119	HVAC	MECH	UNFO	LATENT	12974	6
919037	REPLACE AIR HANDLERS MEZZ 7,14	593000	510	120	HVAC	MECH	UNFO	LATENT	4149	0

919037	REPLACE AIR HANDLERS MEZZ 7.14	593000	510	122	HVAC	MECH	UNFO	LATENT	13602	14
919037	REPLACE AIR HANDLERS MEZZ 7.14	593000	510	124	HVAC	MECH	UNFO	OWNER	-8585	0
919037	REPLACE AIR HANDLERS MEZZ 7.14	593000	510	121	HVAC	STRUC	DSGN	OWNER	74108	36
919037	REPLACE AIR HANDLERS MEZZ 7.14	593000	510	123	HVAC	STRUC	DSGN	OWNER	55552	79
921008	HVAC IMPROVEMENTS USCG	434850	180	136	HVAC	MECH	UNFO	LATENT	21201	64
921008	HVAC IMPROVEMENTS USCG	434850	180	137	HVAC	MECH	CREQ	OWNER	7520	30
929011	REPAIRS TO A/C CONTROLS B 89	235204	90	70	HVAC	MECH	DELAY	DELAY	0	30
929011	REPAIRS TO A/C CONTROLS B 89	235204	90	71	HVAC	MECH	UNFO	OWNER	5243	0
929011	REPAIRS TO A/C CONTROLS B 89	235204	90	72	HVAC	MECH	UNFO	OWNER	1516	0
929016	REPLACE COOLING TWR HYDRAULIC SH	119735	210	140	HVAC	MECH	CREQ	OWNER	31971	60
929016	REPLACE COOLING TWR HYDRAULIC SH	119735	210	141	HVAC	MECH	UNFO	OWNER	1089	0
929020	REPLACE HVAC SYS HYDRAULIC SHOP	183393	180	144	HVAC	MECH	UNFO	LATENT	3954	25
937688	REPLACE HVAC BLDG 100	124000	180	87	HVAC	MECH	CREQ	OWNER	967	7
937688	REPLACE HVAC BLDG 100	124000	180	88	HVAC	CIVIL	CREQ	OWNER	-770	0
899043	UPGRADE WAREHOUSE B 22	103038	360	13	RENOV	ELEC	UNFO	DESIGN	26300	253
899043	UPGRADE WAREHOUSE B 22	103038	360	12	RENOV	ELEC	CRIT	IMPRVDINF	-235	0
909046	PAINT MOQ HOUSING	166119	90	24	RENOV	STRUC	UNFO	LATENT	8346	0
919005	REPLACE ROOFING IN HOUSING	319571	360	28	RENOV	N/A	DELAY	DELAY	0	60
919021	REPAIR ELECTRICAL PHASE III B 1	145310	270	49	RENOV	N/A	DELAY	DELAY	6000	0
919021	REPAIR ELECTRICAL PHASE III B 1	145310	270	48	RENOV	ELEC	UNFO	LATENT	52432	169
919021	REPAIR ELECTRICAL PHASE III B 1	145310	270	47	RENOV	ELEC	CREQ	OWNER	796	0
920627	BEQ IMPROVEMENTS B 1746	3598000	360	125	RENOV	STRUC	UNFO	OWNER	34338	30
920985	ELECTRICAL/GATEHOUSE MODS	205000	120	131	RENOV	ELEC	CREQ	OWNER	15554	0
920985	ELECTRICAL/GATEHOUSE MODS	205000	120	132	RENOV	CIVIL	CREQ	OWNER	25000	30
920985	ELECTRICAL/GATEHOUSE MODS	205000	120	133	RENOV	CIVIL	CREQ	OWNER	16907	20
920985	ELECTRICAL/GATEHOUSE MODS	205000	120	134	RENOV	CIVIL	UNFO	OWNER	3500	10
920985	ELECTRICAL/GATEHOUSE MODS	205000	120	135	RENOV	CIVIL	UNFO	OWNER	700	33
929001	ROOF REPAIRS HANGARS 44,45,46	258601	180	6	RENOV	STRUC	CREQ	LATENT	9742	133
929004	REPAIRS TO HANGAR 41	377770	180	64	RENOV	N/A	DELAY	DELAY	0	24
929004	REPAIRS TO HANGAR 41	377770	180	63	RENOV	STRUC	UNFO	LATENT	6743	60
929004	REPAIRS TO HANGAR 41	377770	180	62	RENOV	STRUC	CREQ	OWNER	3996	45
929005	REPAIRS TO HANGAR 51	575000	360	138	RENOV	STRUC	CREQ	OWNER	18301	156
929005	REPAIRS TO HANGAR 51	575000	360	139	RENOV	STRUC	CREQ	OWNER	8499	0
929006	REPAIRS TO HANGAR 55	412394	180	66	RENOV	STRUC	UNFO	LATENT	30266	126
929006	REPAIRS TO HANGAR 55	412394	180	65	RENOV	MECH	UNFO	OWNER	40000	0
929007	REPAIRS TO HANGAR 56	451000	360	67	RENOV	STRUC	CREQ	OWNER	61000	60
929008	REPAIRS TO HANGAR 57	441504	180	68	RENOV	STRUC	UNFO	LATENT	25052	100
929009	REPAIRS TO HANGAR 58	639000	360	69	RENOV	STRUC	CREQ	OWNER	58051	92
929027	REPAIR/REPLACE VARIOUS ROOFS	269355	180	75	RENOV	N/A	DELAY	DELAY	0	48
929027	REPAIR/REPLACE VARIOUS ROOFS	269355	180	74	RENOV	STRUC	UNFO	LATENT	5004	45
929027	REPAIR/REPLACE VARIOUS ROOFS	269355	180	76	RENOV	N/A	LDS	LDS	-6400	32
929027	REPAIR/REPLACE VARIOUS ROOFS	269355	180	73	RENOV	STRUC	CREQ	OWNER	7272	56
929036	REPLACE FIRE PROT SYS ENG TEST CE	592618	180	35	RENOV	N/A	CREQ	OWNER	22777	75
929036	REPLACE FIRE PROT SYS ENG TEST CE	592618	180	36	RENOV	ELEC	CREQ	OWNER	2462	0
929042	REPAIRS TO COAST GUARD HNGR 41	85675	300	77	RENOV	STRUC	UNFO	LATENT	23669	37
929042	REPAIRS TO COAST GUARD HNGR 41	85675	300	78	RENOV	STRUC	UNFO	LATENT	5148	62
929043	REPAIRS TO BLDG 2 NAS	389000	180	150	RENOV	STRUC	UNFO	LATENT	5402	15
929043	REPAIRS TO BLDG 2 NAS	389000	180	151	RENOV	STRUC	UNFO	LATENT	18464	44
929043	REPAIRS TO BLDG 2 NAS	389000	180	152	RENOV	STRUC	UNFO	LATENT	9935	0
929048	REPLACE ROOF BLDG 1	67770	90	156	RENOV	STRUC	UNFO	LATENT	5675	0
929048	REPLACE ROOF BLDG 1	67770	90	157	RENOV	STRUC	UNFO	LATENT	7860	0
937681	ROOF BLDG 215	45826	60	83	RENOV	STRUC	UNFO	DESIGN	3647	0
937684	REPAIRS/MAINT TO BEQ 1736	342613	150	84	RENOV	STRUC	UNFO	LATENT	14777	30
937684	REPAIRS/MAINT TO BEQ 1736	342613	150	85	RENOV	STRUC	UNFO	LATENT	7859	14
937684	REPAIRS/MAINT TO BEQ 1736	342613	150	86	RENOV	STRUC	UNFO	LATENT	3000	0
939359	REPAIRS TO DRMO	43000	180	91	RENOV	N/A	DELAY	DELAY	0	6
939359	REPAIRS TO DRMO	43000	180	90	RENOV	STRUC	CREQ	OWNER	2000	50
909007	REPAIRS TO SO WALL FOUNDATION	107604	180	33	REPAIR	CIVIL	UNFO	IMPRVDINF	-5099	0
909007	REPAIRS TO SO WALL FOUNDATION	107604	180	32	REPAIR	CIVIL	UNFO	LATENTSO	3145	30
909007	REPAIRS TO SO WALL FOUNDATION	107604	180	34	REPAIR	CIVIL	CREQ	LATENTSO	2062	0
909013	REPAIRS TO WASTEWATER TREATMEN	155240	360	19	REPAIR	MECH	UNFO	LATENT	11796	14
909013	REPAIRS TO WASTEWATER TREATMEN	155240	360	16	REPAIR	MECH	UNFO	LATENT	54503	35
909013	REPAIRS TO WASTEWATER TREATMEN	155240	360	17	REPAIR	MECH	UNFO	LATENT	485	0
909013	REPAIRS TO WASTEWATER TREATMEN	155240	360	18	REPAIR	MECH	UNFO	LATENT	21287	150
919022	REMOVE ASBESTOS PIPE INSULATION	236494	180	112	REPAIR	CIVIL	CREQ	LATENT	24996	14
919022	REMOVE ASBESTOS PIPE INSULATION	236494	180	113	REPAIR	CIVIL	CREQ	LATENT	23362	14
919022	REMOVE ASBESTOS PIPE INSULATION	236494	180	114	REPAIR	CIVIL	CREQ	LATENT	127815	46
919022	REMOVE ASBESTOS PIPE INSULATION	236494	180	115	REPAIR	CIVIL	CREQ	LATENT	24179	0
919022	REMOVE ASBESTOS PIPE INSULATION	236494	180	116	REPAIR	CIVIL	UNFO	LATENT	98372	40
929059	PAINT FUEL TANKS	98500	120	79	REPAIR	STRUC	UNFO	LATENT	7303	91

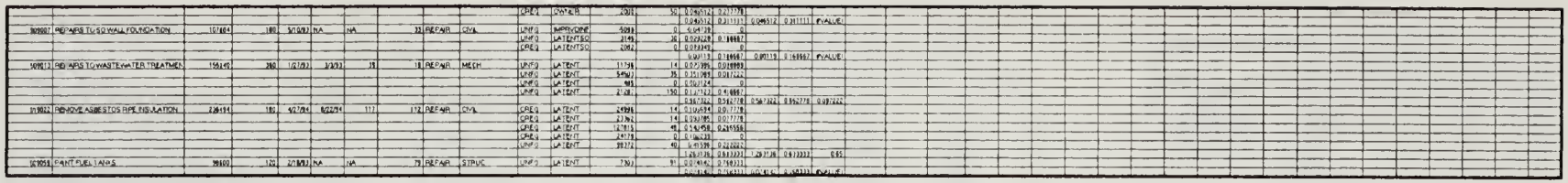
| CONTRACT NUMBER | PROJECT | AWARD ANT | ORIGINAL CONTRACT PERIOD | COD | BOD | DELTA DAYS | CHANGE ORDER NO | PROJECT TYPE | ENGINEERING DISCIPLINE | NAVY REASON CODE | ASSIGNED CODE | CHANGE ORDER AMT | TIME EXTENSION | CHANGE ORDER RATE | TIME EXTENS RATE | | |



C.O. SENSITIVITY RATES FOR HVAC PROJECTS
AWARD AMOUNT
COST RATE (10 AVG)
TIME RATE (36 AVG)
ACTUAL COMP RATE (+ 39 AVG)
CONTRACT
RATE
AWARD AMOUNT

C.O. SENSITIVITY RATES FOR BLDG RENOVATIONS
AWARD AMOUNT
COST RATE (12 AVG)
TIME RATE (41 AVG)
ACTUAL COMP RATE (+ 4 1AVG)
CONTRACT
RATE
AWARD AMOUNT

C.O. SENSITIVITY RATES FOR REPAIR PROJECTS
AWARD AMOUNT
COST RATE (48 AVG)
TIME RATE (53 AVG)
ACTUAL COMP RATE (+ 57AVG)
CONTRACT
RATE
AWARD AMOUNT



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CONTRACT NUMBER	PROJECT	AWARD AMT	ORIGINAL CONTRACT PERIOD	CCD	BDD	DELTA DAYS	CHANGE ORDER NO	PROJECT TYPE	ENGINEERING DISCIPLINE	NAVY REASON CODE	ASSIGNED CODE	CHANGE ORDER AMT	TIME EXTENSION		
883007	UPGRADE BALL PARK	72555	120	8/23/91	9/13/91	21	39	CIVIL	N/A	DELAY	DELAY	0	50		
929045	REPAIR SMALL BERTHING PIER	370000	150	3/24/94	NA	NA	155	CIVIL	N/A	DELAY	DELAY	0	99		
												0	149	0	149
937672	PAVE RUNNING TRACK	97000	90	######	2/1/94	33	82	CIVIL	CIVIL	DSGN	DESIGN	0	18		
										UNFO	DESIGN	748	3		
												748	21	748	21
937662	PAVE ACCESS ROAD ADJACENT TP B	217604	90	2/13/94	1/20/94	-24	80	CIVIL	CIVIL	UNFO	LATENT	6335	0		
929017	REPAIRS TO STORM SEWER	1049279	300	6/1/93	6/1/93	0	142	CIVIL	CIVIL	UNFO	LATENT	155176	34		
										DSGN	LATENT	3764	6		
										UNFO	LATENT	61800	0		
										UNFO	LATENT	19798	46		
												246873	86	246873	86
921007	CIVIL APPS IMPRVTS U S COAST GUAI	525000	360	1/28/94	9/20/93	-129	60	CIVIL	CIVIL	UNFO	LATENTSO	896	0		
										UNFO	LATENTSO	13283	5		
												14179	5	14179	5
										LDS	LDS	-2100	21		
												-2100	21	-2100	21
919009	REPAIR RUNWAYS 13R,13L,31R,31L	293000	90	1/28/93	1/19/93	-9	45	CIVIL	CIVIL	CREQ	OWNER	22348	0		
937693	SEAL CRACKS ALONG RUNWAYS	14850	120	1/25/94	1/10/94	-15	89	CIVIL	CIVIL	UNFO	OWNER	12918	45		
919010	REPAIR TAXIWAYS NAS	1387339	270	3/21/94	NA	NA	108	CIVIL	CIVIL	UNFO	OWNER	120971	30		
										CREQ	OWNER	24058	23		
										CREQ	OWNER	6813	5		
										CREQ	OWNER	1469	1		
												188577	104	188577	104
												188577	104		
919034	DSGN/CONST BOAT STORAGE BLDGS	79789	150	2/12/93	NA	NA	1	CONST	N/A	UNFO	DELAY	0	48		
909045	CONST DELUGE RINSE FACILITY	487000	360	NA	NA	NA	21	CONST	N/A	UNFO	DELAY	0	7		
919019	INSTALL FLIGHTLINE FENCE	100186	240	6/10/92	7/1/92	21	109	CONST	N/A	DELAY	DELAY	0	37		
										UNFO	DELAY	0	35		
										DELAY	DELAY	0	21		
												0	148		
919023	CONST PEST CONTROL FACILITY	22078	360	NA	NA	NA	29	CONST	STRUC	DSGN	DESIGN	1283	14		
899055	CONSTRUCT RADIOACTIVE STORAGE	216900	360	4/12/93	2/17/94	311	95	CONST	ELEC	DSGN	DESIGN	2353	3		
910567	AIRCRAFT INST REPAIR/CALIB FACILIT	5191000	630	4/22/93	6/24/93	63	103	CONST	ELEC	DSGN	DESIGN	1598	0		
920983	MSO/WPB SUPPORT FAC USCG	667750	480	######	4/20/95	192	126	CONST	STRUC	DSGN	DESIGN	14163	30		
										CRIT	DESIGN	730	0		
												20127	47		
										UNFO	IMPRVDNI	492	0		
												-492	0		
										UNFO	LATENT	1400	0		
										UNFO	LATENT	2974	6		
										UNFO	LATENT	19605	54		
										UNFO	LATENT	0	71		
												21179	131		
899046	DEMOLISH HOUSING UNITS	82750	120	######	3/29/93	91	14	CONST	CIVIL	UNFO	LATENTEN	38711	88		
										UNFO	LATENTEN	12960	0		
												51671	88		
929058	CONST HAZ WASTE MATERIAL STOR	110000	180	4/16/93	NA	NA	7	CONST	CIVIL	UNFO	LATENTSO	615	0		
										UNFO	LATENTSO	2429	15		
												3044	15		
900630	ENGINEERING ANALYSIS FACILITY	2717640	480	5/27/94	9/22/94	118	98	CONST	ELEC	CRIT	LDS	-203	0		
												203	0		
										CREQ	OWNER	-4986	0		
										CREQ	OWNER	0	60		
										CREQ	OWNER	7025	21		
										CREQ	OWNER	39542	45		
										CREQ	OWNER	528	2		
										UNFO	OWNER	4205	0		
										CREQ	OWNER	2617	2		
										CREQ	OWNER	4810	0		
										DSGN	OWNER	94144	0		

ANALYSIS OF CIVIL CHANGES

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	149	0%	41%
DESIGN	$748	21	0%	6%
LATENT COND	$246,873	86	55%	24%
LATENT COND-SOILS	$14,179	5	3%	1%
OWNER	$188,577	104	42%	28%
TOTAL	$450,377	365		

ANALYSIS OF NEW CONSTRUCTION CHANGES

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	148	0%	23%
DESIGN	$20,127	47	7%	7%
INFORMATION	($482)	0	0%	0%
LATENT COND	$21,179	131	7%	20%
LATENT COND-ENVIR	$51,671	88	18%	14%
LATENT COND-SOILS	$3,044	15	1%	2%
OWNER	$190,624	212	67%	33%
TOTAL	$286,153	641		

										CREQ	OWNER	7286	45	
										UNFO	OWNER	14931	7	
										UNFO	OWNER	20522	30	
												190624	212	
870016	AIRFIELD LIGHTING UPGRADE NAS	3529000	720	######	NA	NA	93	ELEC	ELEC	UNFO	DESIGN	63013	192	
												63013	192	
910413	PRIMARY DISTRIBUTION UPGRADE	1239583	480	######	3/3/93	72	41	ELEC	ELEC	UNFO	LATENT	11153	0	
										UNFO	LATENT	38596	98	
												49749	98	
										CREQ	OWNER	405	0	
										UNFO	OWNER	53957	47	
										UNFO	OWNER	22109	0	
												61661	47	
929031	REPLACE UST AT FAC 1153	250000	420	2/16/92	5/11/94	815	149	ENVIR	CIVIL	DELAY	DELAY	0	147	
												0	147	
919036	REMOVAL OF UNDERGND STORAGE T	154803	360	######	3/3/93	142	3	ENVIR	CIVIL	UNFO	LATENTEN	90290	90	
920676	JPS UST REMOVAL BEEVILLE	466989	120	3/23/93	7/28/93	127	50	ENVIR	CIVIL	CREQ	LATENTEN	74549	120	
920828	RCRA CORRECTIVE ACTION FOR TANK	518831	120	3/22/92	7/6/93	471	55	ENVIR	CIVIL	UNFO	LATENTEN	12079	0	
										UNFO	LATENTEN	21612	90	
										UNFO	LATENTEN	19645	0	
										UNFO	LATENTEN	7329	0	
										UNFO	LATENTEN	4685	7	
										UNFO	LATENTEN	31930	0	
										UNFO	LATENTEN	6960	0	
										UNFO	LATENTEN	37177	0	
										UNFO	LATENTEN	35550	106	
										UNFO	LATENTEN	26354	0	
										UNFO	LATENTEN	16649	30	
												364809	443	
										CREQ	OWNER	4506	30	
										CREQ	OWNER	7600	0	
										CREQ	OWNER	5006	227	
										CREQ	OWNER	5021	45	
												22133	302	
889058	INSTALL LOX/LN TANKS	51610	180	6/17/92	NA	NA	9	EQUIP	ELEC	CRIT	OWNER	165	14	
										CREQ	OWNER	27000	30	
										CREQ	OWNER	35522	411	
919017	UPGRADE WASTE TELEMETRY SYS	60030	90	1/12/93			46	EQUIP	MECH	UNFO	OWNER	6627	136	
929204	IN SITU WATER TREATMENT AVGAS T	24222	360				8	EQUIP	N/A	DELAY	DELAY	0	27	
929011	REPAIRS TO A/C CONTROLS B 69	235204	90	3/29/93	4/28/93	30	70	HVAC	MECH	DELAY	DELAY	0	30	
919004	REPLACE A/C SYSTEM MEZZ 7	89611	360	9/29/94	NA	NA	107	HVAC	MECH	DELAY	DELAY	0	153	
												0	183	
909052	REPLACE AIR COMPRESSOR & COOLIN	538800	360	12/8/92	3/3/93	85	26	HVAC	ELEC	DSGN	DESIGN	1447	3	

ANALYSIS OF ELECTRICAL DISTRIBUTION PROJECTS

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DESIGN	$83,013	192	32%	57%
LATENT COND	$49,749	98	28%	29%
OWNER	$81,861	47	42%	14%
TOTAL	$194,423	337		

ANALYSIS OF ENVIRONMENTAL PROJECTS

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	147	0%	16%
LATENT COND-ENVIR	$384,809	443	95%	50%
OWNER	$22,133	302	5%	34%
TOTAL	$406,942	892		

ANALYSIS OF HVAC PROJECTS

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$0	183	0%	22%
DESIGN	$21,789	100	7%	12%
IMPROVED INFORMATION	($856)	139	0%	16%
LATENT COND	$131,581	209	41%	25%
OWNER	$168,611	212	53%	25%
TOTAL	$321,135	843		

										DSGN	DESIGN	20352	97						
												21799	100						
										UNFO	IMPRVDINF	-856	139						
												-856	139						
919037	REPLACE AIR HANDLERS MEZZ 7,14	593000	510	6/15/93	######	516	117	HVAC	MECH	UNFO	LATENT	7088	3						
921008	HVAC IMPROVEMENTS USOG	434850	180	9/23/93	######	67	136	HVAC	MECH	UNFO	LATENT	21201	64						
929020	REPLACE HVAC SYS HYDRAULIC SHOP	183393	180	NA	NA	NA	144	HVAC	MECH	UNFO	LATENT	3954	25						
										UNFO	LATENT	68613	97						
										UNFO	LATENT	12974	6						
										UNFO	LATENT	4149	0						
										UNFO	LATENT	13602	14						
												131581	209						
937688	REPLACE HVAC BLDG 100	124000	180	NA	NA	NA	87	HVAC	MECH	CREQ	OWNER	967	7						
929016	REPLACE COOLING TWR HYDRAULIC S	119735	210	######	######	0	140	HVAC	MECH	CREQ	OWNER	31971	60						
										UNFO	OWNER	-8585	0						
										DSGN	OWNER	74108	36						
										DSGN	OWNER	55552	79						
										CREQ	OWNER	7520	30						
										UNFO	OWNER	5243	0						
										UNFO	OWNER	1516	0						
										UNFO	OWNER	1089	0						
										CREQ	OWNER	-770	0						
												168611	212						
919005	REPLACE ROOFING IN HOUSING	319571	360	######	######	0	28	RENOV	N/A	DELAY	DELAY	0	60						
919021	REPAIR ELECTRICAL PHASE III B 1	145310	270	5/4/93	######	169	49	RENOV	N/A	DELAY	DELAY	6000	0						
929004	REPAIRS TO HANGAR 41	377770	180	NA	NA	NA	64	RENOV	N/A	DELAY	DELAY	0	24						
929027	REPAIR/REPLACE VARIOUS ROOFS	269355	180	2/10/93	8/10/93	181	75	RENOV	N/A	DELAY	DELAY	0	48						
939369	REPAIRS TO DAMD	43000	180	3/4/94	NA	NA	91	RENOV	N/A	DELAY	DELAY	0	6						
												6000	138						
899043	UPGRADE WAREHOUSE B 22	103038	360	NA	NA	NA	13	RENOV	ELEC	UNFO	DESIGN	26300	253						
937681	ROOF BLDG 215	45826	60	######	NA	NA	83	RENOV	STRUC	UNFO	DESIGN	3647	0						
												29947	253						
										CRIT	IMPRVDINF	235	0						
												235	0						
929001	ROOF REPAIRS HANGARS 44,45,46	258601	180	1/4/93	3/30/93	85	6	RENOV	STRUC	CREQ	LATENT	9742	133						
909046	PAINT MOG HOUSING	166119	90	1/13/92	1/13/92	0	24	RENOV	STRUC	UNFO	LATENT	8346	0						
929006	REPAIRS TO HANGAR 55	412394	180	4/27/93	NA	NA	66	RENOV	STRUC	UNFO	LATENT	30266	126						
929008	REPAIRS TO HANGAR 57	441504	180	5/31/93	NA	NA	68	RENOV	STRUC	UNFO	LATENT	25052	100						
929042	REPAIRS TO COAST GUARD HNGR 41	85675	300	7/12/93	######	99	77	RENOV	STRUC	UNFO	LATENT	23869	37						
937684	REPAIRS/MAINT TO BEQ 1736	342613	150	5/20/94	NA	NA	84	RENOV	STRUC	UNFO	LATENT	14777	30						
929043	REPAIRS TO BLDG 2, NAS	389000	180	4/19/94	4/19/94	0	150	RENOV	STRUC	UNFO	LATENT	5402	15						
929048	REPLACE ROOF BLDG 1	67770	90	6/16/93	9/17/93	93	156	RENOV	STRUC	UNFO	LATENT	5675	0						
										UNFO	LATENT	52432	169						
										UNFO	LATENT	6743	60						
										UNFO	LATENT	5004	45						
										UNFO	LATENT	5148	62						
										UNFO	LATENT	18464	44						
										UNFO	LATENT	9935	0						
										UNFO	LATENT	7860	0						
										UNFO	LATENT	7859	14						
										UNFO	LATENT	3000	0						
												239574	835						
										LDS	LDS	6400	32						
												6400	32						
929036	REPLACE FIRE PROT SYS ENG TEST C	592618	180	4/12/93	NA	NA	35	RENOV	N/A	CREQ	OWNER	22777	75						
929007	REPAIRS TO HANGAR 56	451000	360	8/2/93	NA	NA	67	RENOV	STRUC	CREQ	OWNER	61000	60						
929009	REPAIRS TO HANGAR 58	539000	360	8/30/93	######	78	69	RENOV	STRUC	CREQ	OWNER	58051	92						
920627	BEQ IMPROVEMENTS B 1746	3598000	360	5/7/95	NA	NA	125	RENOV	STRUC	UNFO	OWNER	34338	30						
920905	ELECTRICAL/GATEHOUSE MODS	205000	120	5/25/94	NA	NA	131	RENOV	ELEC	CREQ	OWNER	15554	0						

ANALYSIS OF 8LOG RENOVATION PROJECTS

REASON FOR CHANGE	COST OF CHANGES	ADDITIONAL CONTRACT DAYS	% OF TOTAL GROUP COST	% OF TOTAL ADDITIONAL DAYS
DELAY	$8,000	138	1%	7%
DESIGN	$29,947	253	5%	13%
IMPROVED INFORMATION	($235)	0	0%	0%
LATENT COND	$239,574	835	40%	44%
OWNER	$321,153	659	54%	35%
TOTAL	$596,439	1885		

| | | |

GLOSSARY OF TERMS

ARCHITECT/ENGINEER (A/E): Services for architectural and engineering design provided by consulting firms contracted by the Navy.

CREQ: The reason code used by NAVFAC for contract modifications that are customer requested.

CRIT: The reason code used by NAVFAC for contract modifications that are the result of criteria related to building codes, standards, environmental regulations, etc.

DSGN: The reason code used by NAVFAC for contract modifications that are a result of design error or omission.

ENGINEERING FIELD DIVISION (EFD): A regional subdivision of NAVFAC which is responsible for the planning, engineering, maintenance, and construction of Naval shore facilities within a geographic area.

FEDERAL ACQUISITION REGULATIONS (FAR): The primary regulation used by all Federal Agencies conducting acquisition with appropriated funds. The FAR includes the regulations governing procedures for A/E and construction acquisition.

MILITARY CONSTRUCTION PROGRAM (MILCON): The program used by the Department of Defense for capital improvements of shore facilities. All new construction projects costing in excess of $300,000 are included in the program which is authorized annually by the Congress.

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC): The organization within the Navy which is responsible for the maintenance and construction of all Navy and Marine Corps shore facilities.

OFFICER IN CHARGE OF CONSTRUCTION (OICC): The authorized agent for the Navy who may enter into contractual agreements with A/E's and General Contractors.

RESIDENT OFFICER IN CHARGE OF CONSTRUCTION (ROICC): The field office established by the EFD to administer construction contracts after award.

UNFO: The reason code used by NAVFAC for contract modifications that were a result of unforseen or differing site conditions.

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VITA

Jose Ignacio Barrientez was born in Brownsville, Texas on January 2, 1962, the son of Ignacio and Aurora Barrientez. After graduating from Harlingen High School in 1980, he attended The University of Texas at Austin where he received his Bachelor of Science in Petroleum Engineering in 1984.

After graduation, he worked as a field engineer for Delta Systems, a consulting engineering and surveying firm in south Texas. He entered the Navy in 1986 as a Civil Engineer Corps Officer. His first assignment was Assistant Resident Officer in Charge of Construction, Naval Air Station, Key West, FL. where he managed various construction contracts to include the Radar Air Traffic Control Facility (RATCF) and the PHM Berthing Wharf for the relocation of the U.S. Navy's hydrofoils. In 1989 he was the Staff Civil Engineer at Naval Computer and Telecommunications Station, Rota, Spain where he also had construction management responsibilities. In 1992, he was reassigned as the projects officer at Naval Base, Rota, Spain. He was involved in the planning of the Air Mobility Command relocation from Torrejon Air Base, Madrid, Spain. He entered The Graduate School at The University of Texas in September 1994. He is the prospective Assistant Officer in Charge of Construction at Marianas Islands, Guam.

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